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Vickers Vanguard taking passengers aboard at London Airport (Heathrow)

HOW BEA EARNS MONEY FOR BRITAIN Last year its fleet of turbined-engined aircraft — Viscounts, Vanguards, and Comet 4Bs — flew the airways of Europe to the tune of £28,500,000 in revenue. Of this £14,500,000 was paid in foreign currency — £2,750,000 in dollars. And in 1961 the rate of export earning will soar as BEA increases its passenger and freight capacity.

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SELLING BY FLYING This is only one aspect of BEA's part in the drive for exports. Since, for successful export selling, so much depends on meetings of principals, Britain's businessmen are going abroad — and they are going by BEA. Business executives know that BEA flies to more places more frequently than any other European airline. The spring-boards of the export drive are London's airports.

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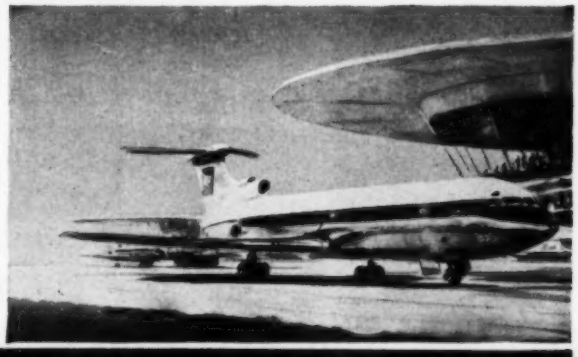
The D. H. Trident



BRITISH EUROPEAN AIRWAYS

The Northrop T-38 supersonic jet trainer is n

is n service with the United States Air Force.

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Titanine aircraft finishes are used on the Avro 748

The new Avro 748 feeder-liner which was designed as a D.C.3 replacement, made its first flight on June 24th, 1960. The 748 carries up to 48 passengers and is powered by two Rolls-Royce Dart turboprop engines.

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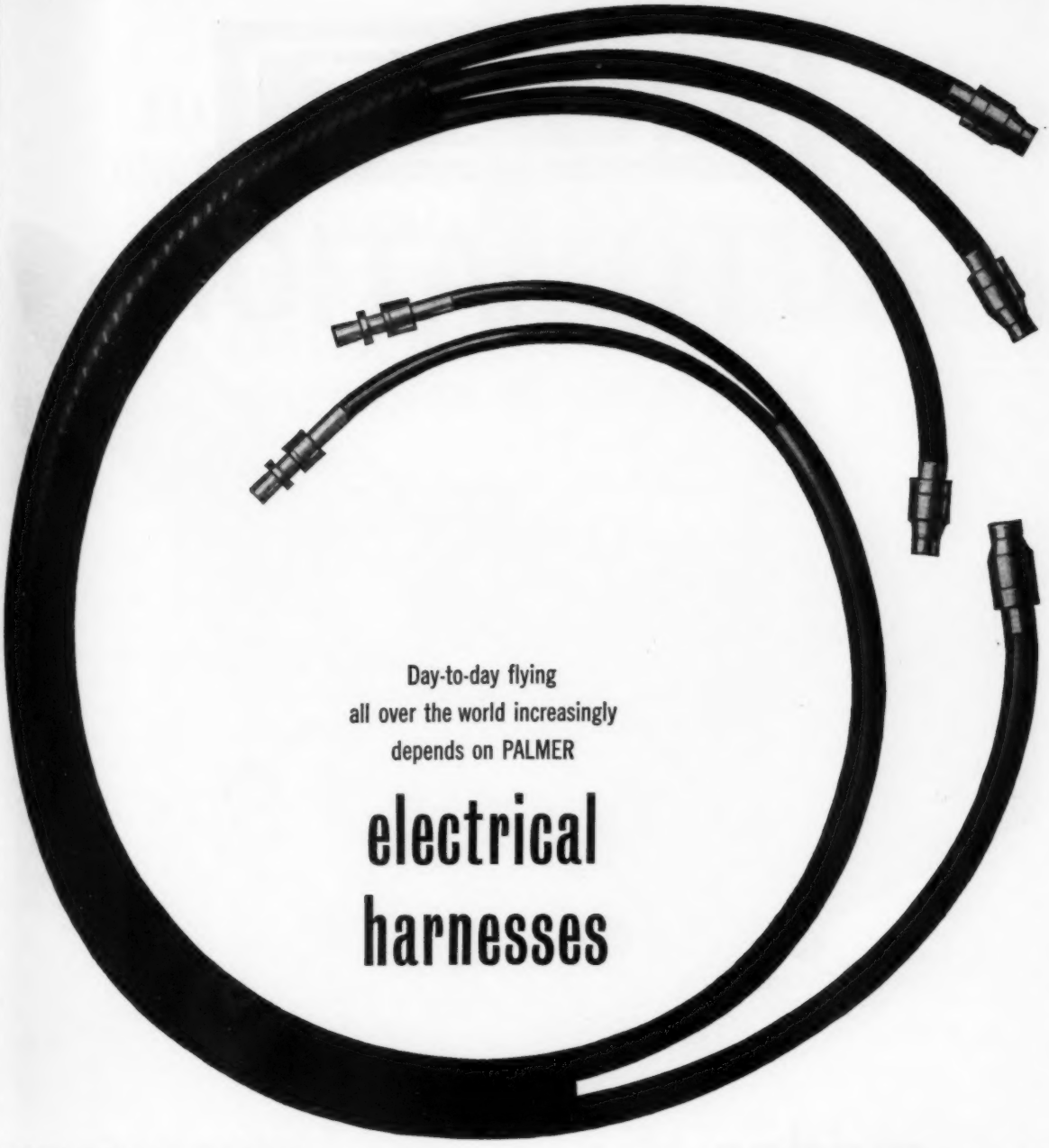

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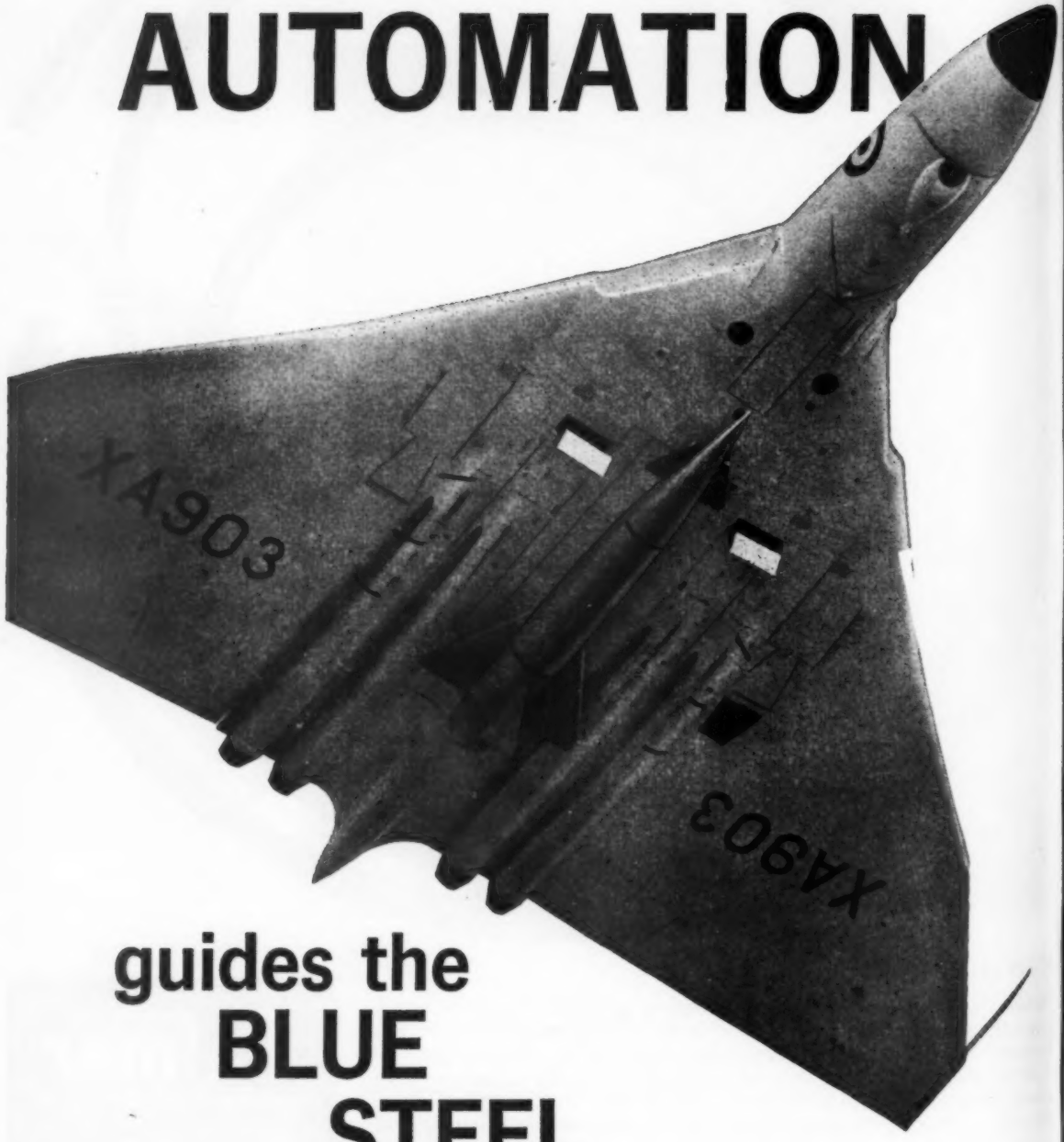

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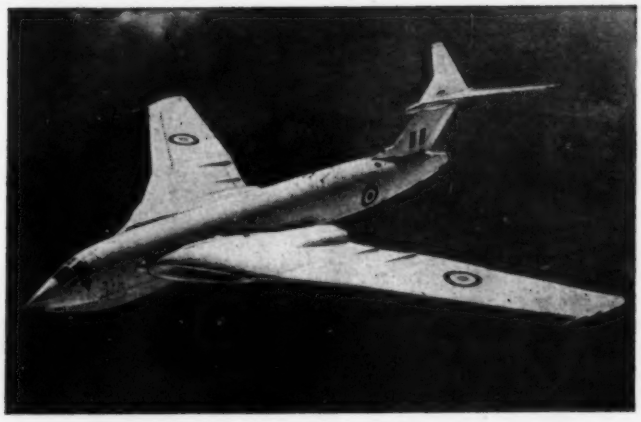

Above is the Handley Page Victor B.2, which together with the AVRO Vulcan forms Britain's Blue Steel carrier team.

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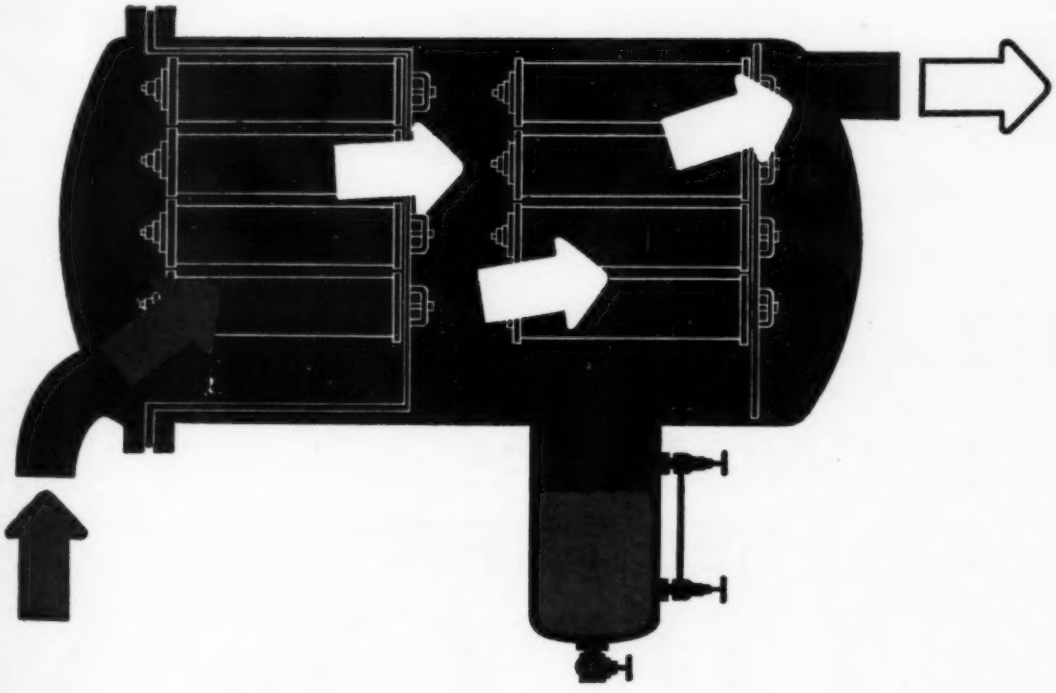

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No 2713 VOLUME 79 FRIDAY 10 MARCH 1961

FLIGHT

AIRCRAFT, SPACECRAFT, MISSILES

Official Organ of the Royal Aero Club First Aeronautical Weekly in the World Founded 1909

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Iliffe Transport Publications Ltd, Dorset House, Stamford Street, London SE1; telephone Waterloo 3333. Telegrams Flightpres London SE1. Annual subscriptions: Home £4 15s. Overseas £5. Canada and USA $15.00. Second Class Mail privileges authorized at New York, NY.

Branch Offices Coventry: 8-10 Corporation Street; telephone Coventry 25210. Birmingham: King Edward House, New Street, 2; telephone Midland 7191. Manchester: 260 Deansgate 3; telephone Blackfriars 4412 or Deansgate 3595. Glasgow: 62 Buchanan Street C1; telephone Central 1265-6.

New York, NY: Thomas Skinner & Co (Publishers) Ltd, 111 Broadway 6; telephone Digby 9-1197.

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The Americans Get Tough

A LITTLE over a year ago, on January 8, 1960, we warned on this page that the Americans were attentively watching BOAC's North Atlantic pool agreements with TCA, Air-India and Qantas. We said: "They have one ace up their sleeve should these or any other airline blocs seriously challenge the influence and bargaining powers of America's international airlines. The Americans are very hostile towards cartels, and it is conceivable that US anti-trust laws could be invoked to question the monopolistic nature of airline groups should ever disputes arise about traffic rights."

Sure enough, as noted on page 321 of this issue, the Americans are now playing their ace. The Civil Aeronautics Board has given BOAC, Qantas and Air-India until April 12 to say why details of their North Atlantic pool should not be subject to scrutiny. Pan American are behind this move. This airline is in effect saying to the CAB: "The foreign air carrier permits you have issued to these airlines—which require them to abide by US anti-trust laws—are invalidated by anti-trust pooling practices." In reply, BOAC have in effect said to the CAB, "mind your own business." But if the CAB insist, it will be up to BOAC and partners to prove that their pool is in the public interest.

The pool partners deplore this attempt by the Americans to inquire into what they feel is a private affair. But at issue is the big *general* question of whether airline pooling should be called to account. Perhaps there is a lesson here for our new Air Transport Licensing Board (which is due to hold its first hearing next Tuesday). The Board is statutorily required to protect any pool agreement "reasonably entered into" by any holder of an air service licence. But, as we have also said before, it will be a pity if our airlines feel that they have only "to wave a secret pool agreement at the Board to ensure that their operations will be protected." So extensive now is pooling among British and foreign airlines (BEA's international services are 100 per cent pooled) that, unless there is public accountability, the work of the Board will be constantly frustrated. Pools may—as their adherents insist—be good things. But they must be seen to be good things.

Europe's Space Potential

A LOGICAL step along Europe's road into space was last week's announcement of joint studies conducted by Hawker Siddeley Aviation and the French SEREB company. Particular merit lay in the fact that the industrial interests concerned did not attempt to speak for scientists or for governments, but for industry alone. Perhaps the only major criticism is that the cost estimates quoted in the joint report are unrealistic, partly because the report itself had been overtaken by inter-governmental events and partly because launch-vehicle costs cannot be determined without knowing the types of rocket to be used.

The main significance of the joint studies is that they have been carried out by some of the major companies which will be involved when and if the official European space programme gets under way. Other companies with a stake in space—including the impressive electronics potential of AEI, Decca and Pye, and the Blue Streak team of de Havilland and Rolls-Royce—are already founder-members of the British Space Development Company.

It will be essential for the Hawker Siddeley/SEREB association and the Space Development Company to avoid wasteful competition. The industrial backing for Europe's entry into space has been clearly demonstrated, and it is now up to the governments concerned to plan and define a firm programme.

FROM ALL QUARTERS

The AW.660 Flies

THE AW.660 military Argosy made its maiden flight from Armstrong Whitworth's airfield at Bitteswell, Leics, last Monday, March 6. The first of 56 Argosy C.1 aircraft for RAF Transport Command, it was airborne for 1hr 50min, and the company's chief test pilot, Mr Eric Franklin, described the flight as "satisfactory." The AW.660 is considerably heavier and more powerful than the commercial AW.650, and was fully described in our February 10 issue.

Project Horizon

A SPECIAL group has been created by President Kennedy "to study and recommend national aviation targets for the next ten years." In a letter to Mr N. E. Halaby, sworn in last Friday as administrator of the FAA, the president said that definition of these objects was essential if the United States was to have a safe, efficient and economical national aviation system. The group's task will be known as "Project Horizon."

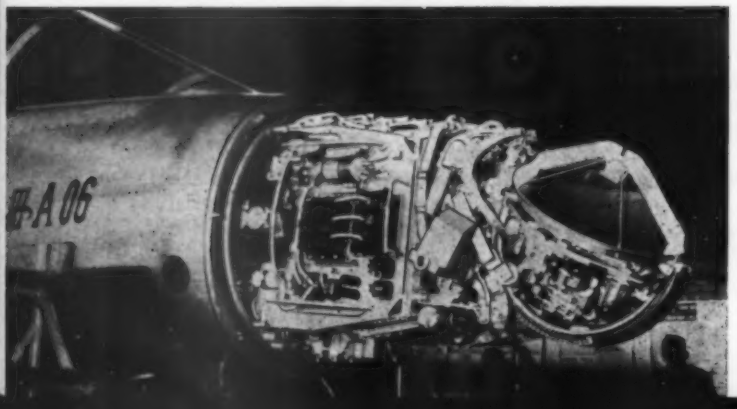
Paris Show Programme

BECAUSE of traffic requirements at Le Bourget airfield, the programme for the XXIVth Paris Salon has been revised and is now as follows: Friday (May 26) inauguration; Saturday, stamp collectors' day; Sunday, commercial, executive and light aviation; Monday, ambulance and medical aviation; Tuesday, electronics; Wednesday, spaceflight; Thursday (June 1), rotary-wing aviation; Friday, foreign missions; Saturday, international flying display; Sunday (June 4), international air show.

Naval Hovercraft?

IN a debate on the Navy Estimates last week, Mr Orr-Ewing, Civil Lord of the Admiralty, said of the Hovercraft: "We are keeping in close touch with developments here, because we foresee some important naval applications of the principle as soon as the hover height can be increased sufficiently to allow the craft to be operated in a great variety of sea conditions. For example, the ability of the Hovercraft to operate equally well over land and water makes it attractive for amphibious warfare and ferrying duties. It might also be used for coastal forces, for air-sea rescue work, and, possibly, for mine hunting. There is even a hope that it might be developed into a useful anti-submarine weapon. All three Services are interested in it, but in view of its apparently wider marine application the Admiralty is co-ordinating its initial development for Service use."

SAFER SINGLE-ENGINE OPERATION is the primary reason Cessna have chosen to design their new executive aircraft, the Skymaster, to the "push-pull" formula, as seen here. A four-seater, it is claimed to outperform anything in the low price twin-engined field



Mr Orr-Ewing also made allusion to the Mk 2 Seaslug, which will have greater range, greater height and a more powerful high-explosive warhead. Of electronic computers he said the first application would be in the carrier *Eagle*. The equipment would be known as Action Data Automation and would track and classify targets automatically. It would store and display information and would calculate and recommend solutions; and it would prepare and accept information for automatic exchange between other ships in its own or adjacent task forces.

Return to AWA

Mr Eric Greenwood

A NEW POST has been announced for Mr Eric Greenwood, OBE, FRAES, formerly with the Hawker Siddeley Aviation international sales staff; he has rejoined Sir W. G. Armstrong Whitworth Aircraft, the company with which he started his test flying career, as chief executive to the managing director, Mr W. S. D. Lockwood. He will be based in London.

Mr Greenwood is a former chief test pilot of Gloster Aircraft and flew Britain's first jet aircraft, the Gloster/Whittle E28/39. He did much of the test flying on the Gloster Meteor, the only Allied jet to see service in the Second World War, and was closely concerned in the successful world speed record bids by this aircraft in 1945 and 1946. He is claimed to have been the first to exceed 600 m.p.h., and for his pioneering work was made an OBE. He was also the first pilot in the world to fly a turboprop aircraft, the Trent Meteor. Before the war, Mr Greenwood served with the RAF, then in 1936 became an assistant test pilot at Armstrong Whitworth Aircraft. He took part with Mr Turner-Hughes in the first flight of the Ensign, then the largest aircraft in the world. Five years later he was made chief test pilot of Air Service Training, before taking up a similar post at Gloster Aircraft in 1943.

Flockhart Unlucky

TIRED and rather angry, but not despondent, racing driver Ron Flockhart abandoned at Athens last Saturday a valiant attempt to fly solo from Sydney to London faster than anyone in a private piston-engined aeroplane had ever done before. His sights were set on the record established by Clouston and Ricketts in the Gipsy-engined Comet racer—130hr 3min—in 1938. When he abandoned his attempt, owing to overheating of the Packard-Merlin 38 of his red Mustang 20, he was 30hr inside the record.

The attempt was made at the end of the Antipodean motor racing season, the Mustang being purchased by United Dominions Trust for the purpose from Arnold Glass, a well-known motoring and aviation enthusiast who holds the unofficial trans-Timor record in the same Australian-built aircraft. When Flockhart took it over it had flown about 100hr since new, all in private hands.

The significance of last week's flight is that it was made with limited professional backing by a club-trained pilot. Though experienced, Ron Flockhart holds no instrument rating and for the majority of the journey he navigated "contact" from 1:1,000,000 maps. In the limited space available in the cockpit, two German Becker VHF sets were installed to give a total of 36 communications channels, and a Lear T12 ADF was fitted in the position normally occupied by the gun-sight. This was the total radio-navigation equipment available; there was no VOR, ILS, marker beacon receiver, or HF radio.

Preparation of the aircraft for the flight—including the installation of two 75 US gal combat tanks to bring total fuel to 350gal, modification of the fuel system and checking of the Packard Merlin—occupied several weeks, and the pilot had flown the Mustang for only 12hr (and none of this at night) when he took off from Sydney on February 28.

But it was not flying the aircraft that gave him any difficulty nor, in practice, did he find much hardship in navigating by "eyeballs

NOSE FOR BUSINESS: This rare photograph of the CSF Cyrano fire-control radar was obtained in Switzerland and sent to "Flight" by the French journal "Aviation Magazine." CSF still maintains that both Swiss and Australian governments have chosen Cyrano for their Mirages. Of large dimensions, the equipment automatically controls missile launching or toss-bombing and also provides mapping and terrain-clearance displays, indicating a "safe plane of operation" during attacks on ground targets in hilly country. Note the twin-wave-guide aerial feed and rack-and-pinion aerial tilting. First details of Cyrano and related GCI equipment appeared in "Flight" for August 28, 1959

INTERNATIONAL HOOK-UP by a B-66 of the USAF to a Valiant of the RAF in Operation Flood Tide, the RAF-USAF in-flight refuelling tests held recently at Sculthorpe (this page, last week)

and ADF." The greatest hazard was (he told *Flight*) the paperwork that is seemingly inseparable from flying internationally, even after all the preparation that goes with a record attempt.

Flockhart's intended route was Sydney - Alice Springs - Darwin - Surabaya - Singapore - Rangoon - Calcutta - Karachi - Bahrein - Beirut - Brindisi - Nice - London. He diverted to Bacau, Timor, to take on extra fuel, but met no trouble except an oleo snag until he reached the Lebanon. Maximum endurance of the Mustang was seven hours, for six of which the pilot might be on oxygen, and a typical cruising speed was 225kt at 12,000ft, although on occasion the aircraft cruised at up to 280kt IAS.

Confusion on the ground at Beirut, when the attempt was going well, brought engine temperatures dangerously high, and the coolant boiled while the Mustang was held waiting for other aircraft to land. The aircraft was still in good shape on the way to Brindisi, but poor weather decided Flockhart to divert to Athens, the nominated alternate. Here he refuelled rapidly, asked the tower for radio clearance, was refused, asked again for permission to file an airborne flight plan, and again was refused. It was also demanded that he should personally pay landing fees for which prior-payment arrangements had already been made by the ever-helpful Esso. Temperatures rose—in the tower, in the cockpit and in the cylinder heads. Tired and dispirited, Flockhart climbed out and went to bed for a short sleep. When he returned to start the aircraft early in the morning, steam issued from the cowlings. He refilled the coolant system, but water ran out between the distorted head joints of Nos 3 and 4 cylinders on the starboard bank. His race was run.

HP's Slewed Wing

NOW added to the list of Handley Page projects for giant transport aircraft of unorthodox conception is a Mach 2 all-wing machine on the "slewed wing" principle. Sweep angle for cruise is 72°. The four podded underslung engines are pivoted, as are the fin and rudder.

The design recalls a Blohm & Voss project of the last war which had a pivoted wing on a conventional fuselage. Since then several agencies, especially in the USA, have investigated the slewed wing, both for laminarized high-subsonic transports and for non-laminarized supersonic applications.

The BLC Hercules

AS noted in *Flight* of February 17, a proposal has been advanced for production in this country of the Lockheed C-130C (BLC-130), which is a forthcoming variant with boundary-layer control. A recent announcement by Lockheed runs:—

"There is a requirement in UK and Europe for a STOL (short take-off and landing) transport to supplement the AW.650 and the Short & Harland Belfast. Lockheed Aircraft Corporation suggests that the British aircraft industry might build the BLC-130 under licence to meet this tactical need. BLC-130 development up to date has been paid for by the USAF to meet the existing requirements of the US Army. The recent decision of President Kennedy to double the production of the basic Hercules postpones the BLC-130 production programme for the USAF. The continuing need for the BLC-130 means that the United States would welcome a British programme to carry BLC development further. This implies an American contribution towards that development . . .

"The BLC-130, if selected by the RAF, would, of course, have Rolls-Royce engines for both propulsion and BLC. The cost of this programme is about £3,500,000, part of which might be met with USAF funds. From go-ahead to first flight would take approximately 36-40 months. The British aircraft industry has recognized the possibilities of this scheme and is already working on it. If carried out, it will be a British project."

IN BRIEF

Representatives of the West German Ministry of Defence and Luftwaffe have been visiting Britain this week to examine the Hawker P.1127.

A British Association of Helicopter Operators has been formed and registered as a company limited by guarantee, without share capital. The initial number of members is 50.

The Royal Automobile Club have awarded the Segrave Trophy for 1960 to Tom Brooke-Smith "for his outstanding flight test work during the development of the Short SC.1, culminating in its demonstration . . . of transition from vertical to horizontal flight."

"FLIGHT": PUBLISHER'S ANNOUNCEMENT

BEGINNING with next week's issue, dated March 16, "Flight" will be published on Thursday of each week—one day earlier than at present.

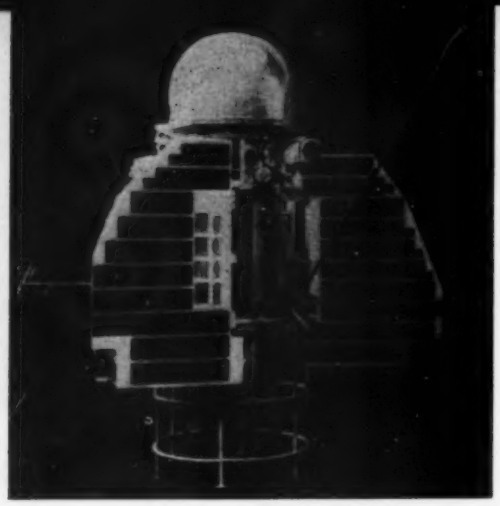
Representatives of Stanley Aviation Corp, Denver, Colorado, are touring England to inform interested engineers about employment possibilities in the US with this aerospace research and development company, currently engaged in high-speed emergency aircraft and space vehicle system programmes, in addition to other related projects. About 30 per cent of the company's design team are British.

Last Sunday, March 5, was the 25th anniversary of the first flight of the prototype Spitfire, K5054. The story of the Spitfire's development and employment is told in unprecedented detail in a recently issued book *Spitfire—The Story of a Famous Fighter*, published by Harleyford Publications Ltd, Letchworth, Herts, at 45s.

A Westland Widgeon of British United Airways was used last Sunday to deliver equipment to the top of the new Shell building on the south bank of the Thames, at a height of 350ft. The operation was successful apart from one misadventure, when a 660lb piece of air-conditioning equipment fell into the river. Four loads, lifted from the Westland heliport at Battersea, were deposited on the 25-storey building.

TIGERJAGER: Three Tiger Moths have been rebuilt by Film Aviation Services Ltd to resemble as closely as possible a Fokker D.VII and two Rumpler C.5s (the "D.VII" is seen here). They will be used in the production "Seven Pillars of Wisdom." Flying trials of the aircraft will be completed before location work on the film begins in Jordan

RED MUSTANG was the callsign used by Ron Flockhart in his attempt on the Sydney - London piston-engined record (see news story in these pages). The aircraft was given a temporary British registration for the flight, and it is hoped that it will race in England this summer. Failure to complete the distance was no reflection on the Merlin engine



Two views of the "automatic interplanetary station," mounted on a display stand. The pivoting antenna is said to be in the half-opened position. On to the framework of the parabolic antenna a continuous surface has been apparently retouched

Missiles and Spaceflight

DETAILS OF THE VENUS PROBE

THIS description of the Soviet Venus probe is taken from the article "The First Flight to Venus" which appeared in "Pravda" of February 26. News of the progress of the probe is given on page 302.

ON February 12, 1961, in the Soviet Union the flight of an automatic interplanetary station began along a trajectory to the planet Venus . . . Powerful engines boosted a multi-stage rocket . . . When the speed of the rocket had reached the first cosmic speed, a heavy satellite separated from the rocket, carrying a cosmic rocket on which was mounted an automatic interplanetary station (AIS). The satellite moved in a near-circular orbit with a minimum distance from the centre of the Earth of 6,601km (4,102 miles), maximum distance of 6,658km (4,137 miles), and orbital inclination to the Equator of 65°.

The cosmic rocket was launched from the satellite at a predetermined point on the orbit. When the flight speed of this rocket relative to the Earth became greater than the second cosmic speed by 661m/sec and the rocket reached a predetermined point in space, the engine of the rocket cut out and from it separated the automatic interplanetary station. Its free flight began along a trajectory to the planet Venus . . .

The further movement of the AIS is occurring under the action of the forces of attraction of the Earth, Sun and planets . . . Inside the sphere of action of the Earth, the AIS moves along a near-hyperbolic curve . . . The AIS reached the boundary of the Earth's sphere of action on February 14 at 2300hrs Moscow time, and then had a speed relative to the Earth of about 4km/sec (8,900 m.p.h.) . . . At the time of exit from the sphere of action of the Earth the speed relative to the Sun was 27.7km/sec (61,800 m.p.h.).

Calculation on the received data of orbital measurements shows that the AIS will enter deeply into the sphere of action of Venus. The maximum distance of the AIS from Venus, with movement along the trajectory which it is now following, must be less than 100,000km (62,000 miles) compared with a total journey of 270,000,000km (168,000,000 miles). This bears witness to the high accuracy of injection of the AIS into its trajectory . . .

Measuring-control Complex For control of the AIS, determination of its orbit, and two-way communication with it over distances up to hundreds of millions of kilometres, an automatic measuring radiotechnical complex was created.

The creation of the complex confronted Soviet scientists and engineers with a series of serious problems, connected with ensuring communication over enormous distances, with high accuracy requirements in the determination of co-ordinates, and with the operating reliability of equipment over long periods . . .

The measurement of the elements of the trajectory of the heavy satellite was effected with special facilities located on the territory of the Soviet Union. Information about the functioning of the instruments and apparatus of the satellite was received by radiotelemetry stations established on Soviet territory and also on special ships on the oceans.

The launching of the cosmic rocket from the heavy satellite was controlled by telemetry systems.

After separation of the AIS the short-range measuring complex designed for the conduct of orbital and telemetry measurements began to function. At each short-range measuring station were established special radiotechnical transmitting and receiving/recording structures, including parabolic antennas with apparatus for programmed direction.

The determination of the actual orbit with increasing distance of the AIS from the Earth above 100 thousand kilometres is effected with the radiotechnical facilities of an outer space radio-communication centre. The reception of telemetric information and the control of the apparatus of the interplanetary station over the duration of the entire flight occurs at this centre. By command of the radiolines, corresponding equipment aboard the AIS is switched on and off, the speed of transmission of telemetric information is changed, and power sources are switched over.

The functioning of all facilities on the distant part of the flight of the AIS occurs in accordance with a special programme, which determines the length of the periods of communication, their frequency and the work regime of the equipment.

For the reception of radio signals over great distances, narrow-band low-noise receiving equipment is employed. This necessitates a sufficiently exact calculation of the frequencies being transmitted and received, taking into account the Doppler effect. For the maintenance of a constant frequency on entry to the narrow-band filters of the receivers on the interplanetary station, and at the measuring station, constantly-determined Doppler corrections are introduced into the frequencies being radiated and received.

With increasing distance of the interplanetary station to distances measured in tens and hundreds of millions of kilometres, the power of the signal reaching the Earth is extremely small. For example, at a distance of 70 million kilometres, only 10^{-22} watts would be received on one square metre of the Earth's surface. For the reception of such small signals, even with super-high sensitivity receivers, antennas of large area are required.

At the stations of the outer space radio-communication centre, large aerial installations have been erected, permitting reception of radio signals from sources separated by enormous distances from the Earth.

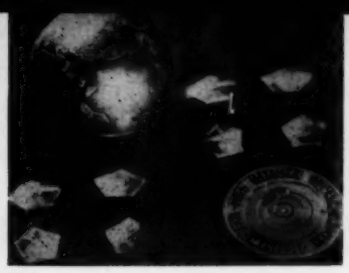
The antenna may be directed to any desired point of the celestial sphere with an accuracy of a few angular minutes. Programmes of direction are automatically introduced into an electronic computing machine, controlling the antennas.

All measurement information is transmitted by automatic lines to a co-ordinating calculating centre, where the calculation of the trajectory measurements is carried out. With the help of rapid-action electronic computing machines the determination of the movement of the AIS is effected, and the direction programmes for the antennas are calculated. The co-ordinating calculating centre effects the management of all ground-measuring services according to the given programme.

Construction of the Station The automatic interplanetary station comprises an apparatus carrying a complex of radiotechnical and scientific equipment, a system of orientation and control, programming units, a system of regulating the temperature, and power sources.

Constructionally the AIS is made in the form of a hermetically sealed hull, consisting of a cylindrical part with two small end-pieces. Inside the hermetically sealed hull of the station, on an equipment frame, is disposed the equipment and blocks of chemical batteries. Outside the hull are located some of the registering instruments of the scientific apparatus, two panels of solar batteries, shutters of the temperature-regulation system, and elements of the orientation system.

To one of the panels of solar batteries is attached a block of heat-registering instruments for investigating the variation of the optical coefficients of different surfaces under conditions of pro-



On board the probe, implying hopes of a direct hit, were these souvenirs: medal (left and far right), hollow titanium globe, and pentagonal pieces of stainless steel. The medal was carried inside the globe, which in turn was carried within an outer case made from the pentagonal pieces

longed exposure in interplanetary space at various distances from the Sun. In addition there are four antennas outside the hull of the station. One of them—sharply directional—has the form of a paraboloid of about two metres diameter. It ensures communication with the interplanetary station at great distances from the Earth, and the transmission of a large volume of information in the course of a small interval of time.

Two cross-shaped antennas attached to the panels of solar batteries have semi-directional form and are designed for communication at medium distances from the Earth.

The omni-directional antenna—a pivoted device 2.4 metres in length—is designed for transmission of information, and determination of parameters of the trajectory during the close-to-Earth phase.

The outside dimensions of the station (without including the antennas and solar batteries) are 2,035mm in length and 1,050mm in diameter.

The weight of the automatic interplanetary station is 643.5kg.

The panels of solar batteries, parabolic and pivoting antennas are in the folded-up condition until the separation of the station from the cosmic rocket and, except for the parabolic antenna, open immediately after the separation. The latter opens with the approach to Venus.

The construction of the station ensures the maintenance inside its hermetically sealed hull of the initial gas pressure, about 900mm of mercury, over the entire duration of the flight.

The shutters of the temperature-regulation system, arranged on the cylindrical part, can rotate to expose and cover a radiating surface, correspondingly increasing or decreasing the dispersal of heat from the equipment on board. Control of the operation of the shutters, and of ventilators arranged inside the hull, is effected with the aid of autonomous programming device with a system of temperature-sensors established in places subjected to the greatest heating or cooling. In this way the problem of ensuring a normal temperature regime for the equipment is solved for the entire trajectory of the flight from Earth to Venus, including the approach of the station to the Sun at a distance up to 110 million kilometres, i.e. with an increase of more than a factor of two in the strength of solar radiation.

Two panels of solar batteries, constantly oriented on the Sun, ensure the uninterrupted charging of the chemical sources of current over the entire trajectory of the flight of the AIS; ensuring power supplies to all systems and equipment.

The radiotechnical complex of the AIS solves the following problems:—

(1) measurement of the parameters of movement of the station relative to the Earth;
(2) transmission to the Earth of the results of measurements made by the scientific instruments;
(3) transmission to the Earth of information about the functioning of the equipment, and internal and surface pressures and temperatures; and
(4) reception from the Earth of radio commands for the control of the operation of the equipment on board.

Control of the operation of the equipment on board the station is effected by the transmission of commands along radio lines from ground points, and also by autonomous programming devices on board the station.

The system of orientation of the AIS solves the following problems during the duration of the flight along the trajectory:—

(1) elimination of the arbitrary rotation of the station received during separation from the cosmic rocket, when launched from the heavy artificial satellite of the Earth;
(2) ensuring the Sun-seeking process from any position of the station and effecting the orientation of the solar batteries towards the Sun in the course of the entire duration of the flight;
(3) ensuring any desired necessary spatial turning of the station and effecting the stabilisation of the station; and
(4) ensuring in the vicinity of Venus the orientation of the highly directional (parabolic) antenna in the direction of the Earth in order to obtain a higher speed of transmission of scientific information, and of information about the operation of the equipment on board, to the Earth.

The AIS is equipped with a complex of scientific apparatus for carrying out physical measurements on the journey from Earth to Venus. At the present time measurements are being made by instruments designed for the investigation of cosmic space far from planets. Among these are instruments for measuring cosmic rays, measuring magnetic fields, measuring charged particles of interplanetary gas and corpuscular currents of the Sun; and registering micrometeorites.

On board the AIS is a small globe containing a representation of the State Arms of the USSR. The globe represents a model of the Earth and is constructed from a titanium alloy in the form of a hollow sphere 70mm in diameter. On the external surface of the sphere is a representation of the outlines of the continents. The surface of the seas and oceans has a light-blue colour, and the continents are golden-yellow.

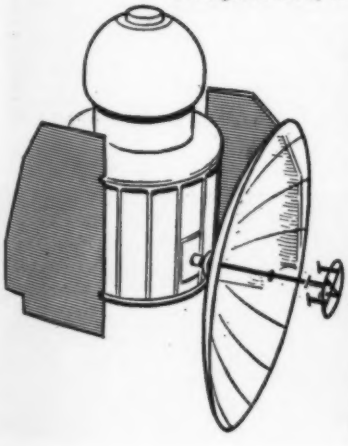
Inside the sphere is placed a commemorative medal with a representation of the State Arms of the USSR. On the reverse side of the medal there is a plan of the solar system in the centre, showing the orbits of Mercury, Venus, Earth and Mars. Around the edge is the inscription *Union of Soviet Socialist Republics—1961*. The relative positions of the planets correspond to the time of the approach of the AIS to the planet Venus.

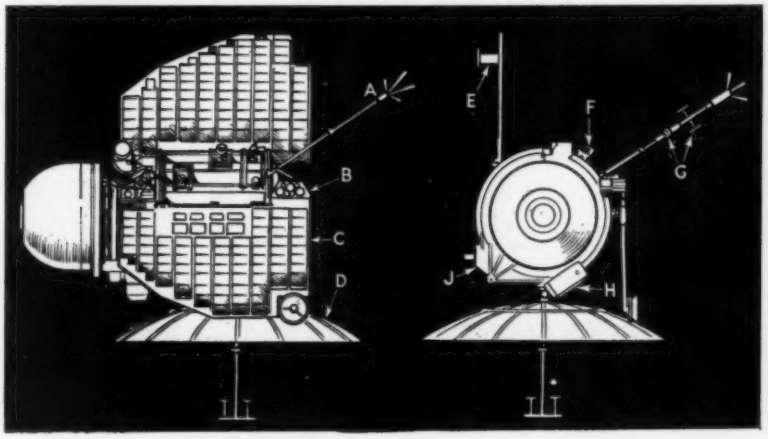
The sphere is placed within a special protective envelope, the external surface of which is formed of pentagonal elements of stainless steel with the representation of the State Arms of the USSR and the inscription *Earth - Venus. 1961*.

The launching of the automatic interplanetary station to the planet Venus opens before science the broadest perspectives of the direct study of cosmic space and the planets of the solar system.

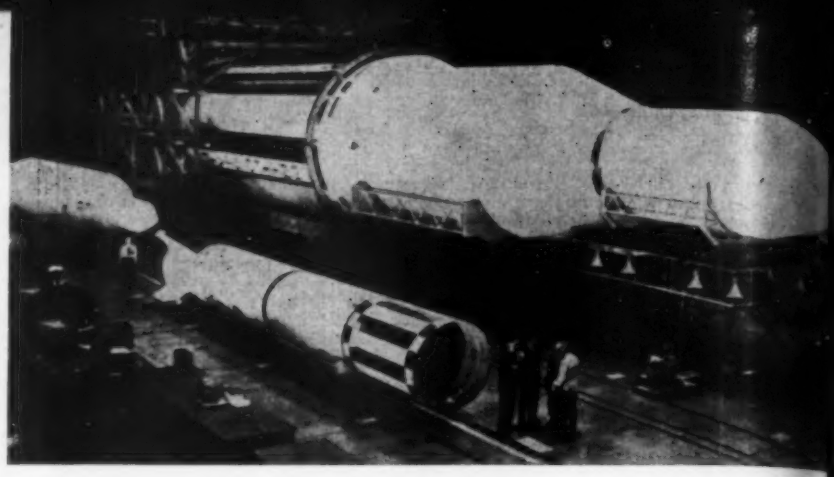
The first interplanetary route has been laid.

Drawings based on Soviet sources, showing (left) simplified sketch of probe geometry, and (right) side and "head-on" elevations of the probe. A Pivoting antenna, B Heat sensors, C Solar cells, D Parabolic antenna, E Semi-directional antenna, F Charged-particle trap, G Magnetometers, H Orientation sensor (Earth), J Precise orientation sensor (Sun and star)





Missiles and Spaceflight . . .



First photograph of the fully assembled three-stage Saturn space booster now under development at the George C. Marshall Space Flight Center, Huntsville. Dummy second and third stages are fitted. In the foreground, for size comparison, are Juno 2 (left) and Redstone-Mercury launching vehicles

CONTACT LOST WITH VENUS PROBE

It was reported from Moscow on March 3 that radio transmissions from the Soviet Venus probe which had been expected on February 27 had not been received. Nothing was received from the probe on February 27 by the large steerable radio telescope at Jodrell Bank—this was the first occasion on which the Jodrell equipment had been in full service and working to co-ordinates provided by the Russians—and it appeared almost certain as *Flight* went to press that contact with the probe had been lost.

Of the earlier attempts by the Jodrell Bank scientists to make contact with the probe, it is possible, but not certain, that signals from the spacecraft were received on either February 17 or 22. Following the news of March 3, Jodrell's big dish was used in an attempt to track the probe for three hours on March 4 and for seven hours on March 5. On March 6 work was carried out to improve the sensitivity of the receiver, and it was hoped to resume the efforts to locate the probe on March 7.

CANADIAN SOUNDING ROCKETS

Airframe components for 15 Black Brant 2 high-altitude research rockets have been delivered to the Canadian Armament Research and Development Establishment at Valcartier, Quebec, by Canadair Ltd of Montreal. Aerodynamic stability tests of the airframe, carrying a Mk 1 engine, were carried out towards the end of last year.

Black Brant 2 is designed to reach altitudes of more than 150 miles in order to collect scientific data concerning the upper atmosphere and ionosphere by means of instrumented nosecones. Canadian research in the upper atmosphere is concerned mainly with phenomena which affect northern communications such as aurora, solar flares and cosmic rays.

The rocket is approximately 30ft in length, of which 15ft is taken up by the engine. Maximum diameter is just over 17in. Launching weight, including fuel and eleven-pound instrument package, is approximately 1½ tons. Research, development and assessment of the rocket engine and propellant were carried out by CARDE scientists and technical officers, while Canadair designed and built the airframe under contract.

BRITISH SOUNDING ROCKETS

Proposals for "the routine measurement of the properties of the atmosphere at very great heights by means of small rockets which, it is hoped, can be launched from a site in the British Isles" were announced in the Secretary of State for Air's Memorandum on the 1961-62 *Air Estimates*. The Minister, Mr Julian Amery, stated at a press conference that the rockets would be of two types, one designed to reach 60km (37 miles) and the other 100km (62 miles).

The first firings in this programme are not likely to take place before 1963, and the most probable sites are Aberporth and South Uist. The planned frequency of launching is one per week for the lower-altitude rocket and one per year for the second type. In the former series measurements will be made of temperatures, movements and composition of the atmosphere; while the higher firings will be directed towards geophysical research and weather forecasting.

A Polaris A-2 extended-range (1,500 n.m.) missile was successfully fired from the trials ship USS *Observation Island* off Cape Canaveral on March 1. The missile, which met all test objectives, was the fourth success in the first five A-2 firings.

French reports dated February 23 stated that five Véronique rockets had been fired since February 10 from the Sahara test site at Hammaguir. This included the rat-carrying launch of February 22. It was also reported that 30 further Véroniques were under construction for upper-atmosphere research.

In a written reply in the Commons on February 13, the Postmaster-General referred to the work of the Post Office Research Station at Dollis Hill and said: "Much of the work on conventional communications will be of great value in the development of satellite communications. More specifically, the research work on satellites includes highly sensitive receivers, large steerable aerial systems, and special transmitting and receiving techniques. Certain aspects are also being studied jointly with the Royal Aircraft and Royal Radar Establishments of the Ministry of Aviation."

During the House of Commons debate on the Navy Estimates on March 2, the Civil Lord said "Further developments will make it possible to produce a version of Seaslug which will be still more effective than the Mk 1 system. The Mk 2 weapon will have greater range, greater height and a more powerful high-explosive warhead." The improved missile will be fitted to the two additional County-class destroyers which will be ordered within the next 12 months, and will be incorporated into the four ships now building as a retrospective modification.

According to a committee of the US House of Representatives, site costs involved in the deployment of ICBMs of Strategic Air Command are now nearly $100m (£35.7m) higher than the original contract prices. A contractor at Ellsworth AFB (see *Flight* for November 4, 1960, page 708) reported 119 changes in the Titan 1 launcher during the past 14 months, adding more than $16m to the overall cost, while another contractor at an Atlas base said modifications had added 1,214 drawings to the 355 included in the original contract. The committee's chairman concludes "Any way you look at this program, things are in a mess."

The Paris meeting of the proposed European Space Research Organisation which was scheduled for March 2-3 (*Flight*, February 24) has been postponed.

It was announced at the US Air Force Missile Test Center on March 1 that the first Titan 2 ICBM will be launched down the Atlantic Missile Range within 12 months. Last month the missile was chosen to replace Titan 1 as the booster for Dyna-Soar, which is now scheduled to be launched by a Titan 2 in the calendar year 1963.

First flight of the Blue Scout 2 four-stage rocket was made from Cape Canaveral on March 3. A successful firing to a height of 1,600 miles was achieved, carrying a 172lb payload designed to study radiation in space. Wrapped around a miniature ionization chamber was a quarter-inch strip of lucite, which absorbs radiation at the same rate as human skin. Instruments in the payload were intended to record electrons, protons, neutrons and gamma rays in the lower Van Allen belt.

Early this month a small group of British journalists visited the Douglas Aircraft Company's missile plant at Culver City to see mock-ups of GAM-87 Skybolt and be reassured that the whole programme has not fallen apart at the seams (as so many writers would have us believe). Douglas were given the go-ahead on May 5, 1959, and appear to be approximately adhering to the original schedule. The USAF project officer on GAM-87 has suggested that it will take three years to develop on the ground and two years to flight-test; mock-ups have already flown.

Black Brant 2, the sounding rocket built by Canadair for the Canadian Armament Research and Development Establishment and described in a news item on this page. Length of the vehicle is approximately 30ft

DART
Herald

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Missiles and Spaceflight . . .

SPACE TOPICS AT THE IAS

DISCUSSIONS on space exploration again formed a substantial part of the programme at the recent annual meeting of the Institute of the Aerospace Sciences, held in New York. Three of the more interesting papers presented on this occasion are here summarized.

Missions to Mars. In the paper *A Study of Manned Nuclear-rocket Missions to Mars*, given by S. C. Himmel, J. F. Dugan, R. W. Luidens and R. J. Weber of the NASA Lewis Research Center, the return manned Mars mission was examined from a general standpoint. The mission was assumed to begin with a 1.35 million lb multi-stage vehicle system in orbit around the Earth. Depending on the weight of the system, the Mars vehicle would either have been injected into orbit as a single unit or assembled in orbit from separate sections delivered by a series of smaller boosters. At the correct time the spacecraft, which was assumed to contain a crew of seven men, would be accelerated by a high-thrust nuclear rocket on to the transfer (or intercept) trajectory to Mars.

Upon arrival at the planet, the vehicle would be decelerated and would enter a planetary orbit. A Mars landing vehicle would detach itself from the primary spacecraft and, carrying two men, would descend to the surface of the planet, relying upon atmospheric drag to effect the necessary deceleration. After a period of exploration the two men would take off by means of a chemical booster and rejoin their comrades in planetary orbit. The return flight to Earth would be accomplished in essentially the reverse manner.

As might be suspected, there were some technical problems to be resolved before the Mars mission could become a reality. The authors first discussed the question of trajectories. For out-and-return trips, there were four parameters to be considered: total trip time, "wait" time at Mars (the exploration period before returning home), the transfer time (from Earth orbit to martian orbit), and the departure date. Because of the eccentricity of the planetary orbits, the results of the trajectory study were direct functions of the synodic period under investigation.

The authors chose to analyse the 1970-71 period and selected for their initial analysis a mission time of 420 days, which included a 40-day wait period at Mars. For a launch on May 19, 1971, an outbound transfer time of 140 days was optimum and required a velocity increment of 12.29 miles/sec. Applied to the vehicle while in Earth orbit, this would be sufficient to propel the spacecraft out to Mars. Obviously, since the realization of a certain velocity increment meant the expenditure of a particular amount of energy, it was desirable to minimize the required increment.

Regardless of the specific mission selected, the magnitude of the total velocity increment required for the out-and-return trip from orbit to orbit was quite high. Vehicle weight increased exponentially with propulsive-velocity increment and it was therefore worthwhile to reduce the velocity increment (or decrement) which had to be provided by on-board propulsive means. The presence of atmospheres on both Earth and Mars suggested that aerodynamic braking be utilized for the deceleration phases of the mission.

Protection against Radiation

The authors next considered the radiation problem. Mars was assumed to have a radiation belt similar to the Earth's so-called Van Allen belts. This source, combined with cosmic rays and the radiation from solar flares, would constitute a major hazard. Solar flares presented an especially severe problem. During the past 20 years six "giant major" flares had been recorded, each of which emitted about 10,000 times the "usual" intensity of radiation. For all except the shortest trips, it was mathematically probable that the space traveller would encounter at least one giant major flare during planetary explorations. The duration of the flares varied from a few minutes to as long as eight hours. To provide crew protection during these times it was necessary to include provision in the space vehicle for a heavily shielded compartment. The question of the exact radiation dosage which would be tolerated by crew members as an "acceptable risk" remained unanswered.

Nuclear Electric Power. Two representatives of the Jet Propulsion Laboratory of California Institute of Technology, T. W. Koerner and J. Paulson, presented a treatise on *Nuclear Electric Power for Space Missions*. Heretofore all spacecraft had relied in the main upon power derived either from batteries or from solar cells to operate their electronics equipment. But it was apparent that, with space vehicles growing ever larger and demanding more power, some power source other than these two means would be required in the near future.

The use of nuclear power sources for spacecraft secondary power appeared to be largely dependent upon the mutual compatibility of the nuclear devices themselves with the missions and corresponding space vehicles. In addition, the nuclear systems would be required to demonstrate sufficient performance advantages over other kinds of power systems to warrant the increased hazards associated with their use.

The most significant power-source parameter was probably specific weight, or the weight per unit power, since this factor determined to a large extent the performance of the system. On the basis of curves presented at the meeting, it appeared that the crossover point from solar photo-voltaic (solar cell) panels to the reactor sources occurred at power levels of from 0.7 to 3kW, corresponding to weights in the range of 400-600lb. The crossover region indicated was based upon missions ranging from Mars to Venus; for missions beyond Mars, the crossover point occurred at lower power levels.

It appeared unlikely that nuclear reactors would come into use until the advent of the Saturn booster system, at which time it would be possible to employ power systems weighing 500lb or more. Missions to Mars, Venus and the Moon held possibilities for reactor systems, particularly since there would undoubtedly be a requirement for operation during the night portion of the planetary cycle. Missions to Mercury also were candidates for nuclear power sources although here, since the Saturn payload was limited, the use of exotic power sources was marginal. And it further appeared improbable that nuclear sources could be employed on missions to Jupiter; once again the Saturn booster could carry only a small payload at that range.

Commercial Applications

Communication Satellites. Leonard Jaffe of NASA presented a paper on *The Application of Satellites for Commercial Communication Purposes*. According to the speaker, there were basically three kinds of communications satellites: the synchronous-orbit (or "stationary" or 24-hour) active repeater satellite; the non-synchronous-orbit (low-altitude) active repeater satellite; and the non-synchronous passive satellite. Significant by its absence from this list was the delayed repeater (e.g. the Courier satellite); little interest had been shown by commercial operators in anything other than instantaneous communications.

The speaker considered each of the three types in turn. The synchronous repeater system would include three satellites spaced 120° apart and placed in equatorial orbit at an altitude of 22,300 miles. Having the same 24-hour period as the Earth, the three satellites could provide global coverage with the exception of the polar regions. An advantage of the system was that the system, being stationary with respect to the Earth, could permit the use of large fixed antennas on the ground.

The long propagation path, however, presented a problem. The time delay for a signal sent on a return trip to the satellite was 0.25sec. With slight delays in the ground distribution system, it would probably take 0.3sec for a signal to reach its destination. The time required for the originator to receive a response was therefore 0.6sec and, if one wished to have a telephone conversation with someone on the opposite side of the Earth, the round-trip delay would be 1.2sec.

This system delay approximated to "push-to-talk" telephone operations and would not impose any great burden upon the users. The greatest technical problem in the synchronous repeater satellite was reliability of the control mechanisms necessary to maintain the correct position and attitude relative to the Earth.

The speaker foresaw lesser problems in the realm of electronics. Achievement of a synchronous orbit was a formidable launching problem, and it was not anticipated that a commercial communications satellite would be orbited before the Centaur vehicle became operational in 1963.

Non-synchronous satellites were attractive because they could easily be placed in orbit by existing means and were small and simple. But a system of active satellites to provide continuous worldwide coverage would require many vehicles. The reduced propagation range would permit reasonable power requirements aboard the satellite without imposing attitude or position controls. If the orbiting altitude were to be 3,000 miles—and it was obviously desirable to stay within the inner Van Allen belt—36 satellites in polar orbit would provide 99 per cent continuous service. Eighteen satellites would allow 90 per cent availability. One disadvantage of the non-synchronous system would be the need for more complex ground systems than with the 24-hour system.

DON ADAMS

Missiles and Spaceflight . . .

ANGLO-FRENCH SPACE PROJECT

ONE of the three types of satellite proposed in the joint report by Hawker Siddeley Aviation and the French SEREB company, reported in last week's issue, is an attitude-stabilized communications version weighing some 550lb and based on studies carried out by the Advanced Projects Group of Hawker Siddeley Aviation at Kingston-on-Thames. Before describing this design it is relevant to record some of the comments on the background to the proposal, i.e., the joint studies made by the two companies, as given by Sir Roy Dobson and members of his staff at a press conference announcing the studies in London on February 28.

The reason for the co-operative work had been expressed in the introduction to the report as follows: "It has seemed to the two firms that it would be in their greatest mutual advantage to exchange their opinions on the technical and industrial aspects of space problems and to give broad outlines of a joint effort in those fields where it seems to them both feasible and desirable." The space problems considered were concerned with the type of programme which Europe might adopt, and governmental and scientific aspects were omitted as being beyond the scope of industry.

There was no link between the two companies' joint work and the official Anglo-French governmental proposals for a European space-launcher organization, Sir Roy pointed out. In particular, the Hawker/SEREB proposals were not based on the assumption that Blue Streak, or indeed any specific rocket, would comprise or form part of the launch vehicle. The report simply indicated the sort of thing which could be aimed at, whatever the vehicle selected.

Neither was there any connection with the European Space Research Organization, nor with the recently formed British Space Development Company—except that de Havilland had been put in as the representative of the Hawker Siddeley Group in the case of the BSDC. After emphasizing that the initiative for action in a European programme must come from the governments, Sir Roy was asked whether, if government support were not forthcoming, the Hawker Siddeley and SEREB companies would go ahead on their own. He replied "No."

Mr Stuart Davies, technical director of the Hawker Siddeley Group, commented; "In this we are trying to attune ourselves to the idea that we are part of a European set-up which can vie with the Americans in this field. . . . We are trying to make an honest commercial use for space engineering." Mr Davies said that the studies had begun on an all-commercial basis, but that they had been widened at the suggestion of the French representatives to include an anti-satellite missile carrying a two-megaton nuclear warhead.

In addition to the two types of communications satellites described in the report, Mr Davies disclosed, another type had been put forward by "the advanced projects group of de Havilland."

The leaders of the Hawker Siddeley team in this joint activity were listed by the Group as Mr Davies, Mr James Floyd, chief engineer of the Advanced Projects Group of Hawker Siddeley Aviation; Mr Michael Golovine, managing director of A.T.S. Co Ltd; Dr W. F. Hilton, head of the astronautics section of the HSA Advanced Projects Group; and Mr H. R. Watson, aerospace director of Armstrong Whitworth Aircraft.

Design of the Satellite. The communications satellite proposal put forward by the Hawker Siddeley engineers is one that, in the company's opinion, can be realized in a comparatively short time. It uses solar power sources, has a relatively simple attitude control system, and a temperature control system based on the radiative properties of specific surface finishes. The total weight of the satellite is about 550lb, and for it to be projected into the specified orbit would require a launching weight/payload ratio of about 350 assuming a specific impulse of 250sec.

Provision for 50-100 two-way speech channels was to be made, depending on the signal quality required. Frequency modulation was decided on and, in order to ensure a high field strength at the ground receiver, the satellite transmitting aerial would transmit a beam which would subtend the Earth at a satellite altitude of about 4,000 miles.

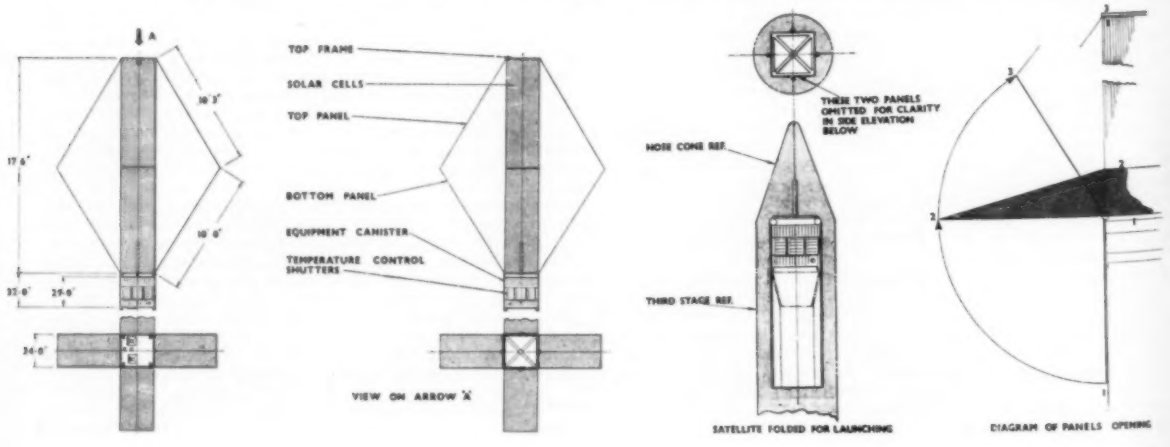
Stabilization of the satellite so that its aerials would be directed towards the Earth at all times was to be effected by the use of infra-red-sensitive photo-cells, stabilizing with respect to the horizon. Initially this system would have to contend with the residual angular velocities after separation, and the erection of the satellite from its horizontal position. To maintain the required attitude, a known but varying angular velocity would have to be applied in the form of a continuous correction. The Earth's gravitational field could be considered as stabilizing, but its effect was negligible compared with the torques necessary to provide the above correction. In addition to this, solar radiation and possible drag effects (especially in the region of perigee) would require constant corrections in stabilization.

It was decided that the attitude control system should rely entirely on propane-fed reaction jets. This was considered preferable to the use of HTP, which would probably have a restricted life, and to the more complicated, mixed reaction jet/flywheel system.

The electronic equipment would generate heat which could seriously affect the operation of the components if not dissipated. The design must therefore include a temperature control system which would maintain the internal temperature of certain components within reasonable limits. This was to be accomplished by the use of specific surface finishes with absorptivity/emissivity ratios permitting the influx and outflow of heat to be regulated.

The attitude-control reaction system was designed to produce control torques at two orders of magnitude. First, there is a relatively high level of torque for the brief separation phase, followed by a succession of much smaller torques throughout the remainder of the active life of the satellite. To meet this requirement economically, a high-pressure nitrogen source is employed to supply thrust at separation and subsequently to pressurize the propane system, which is used thereafter.

Diagrams from the joint Hawker Siddeley/SEREB report "Industry and Space. A Franco-British Study of European Potential," showing the British company's proposal for a communications satellite. Left, the satellite erected; right, folded satellite in launch vehicle, and opening mechanism



The nitrogen at 3,500–4,000lb/sq in is contained in a lightweight vessel with a burster membrane which is punctured by means of a cartridge-operated valve. The pressurized nitrogen then flows in two directions; (a) through a pressure-reducing valve to the solenoid valves governing the operation of the separation torque nozzles, and (b) to the propane reservoir via a pressure-reducing valve.

The propane reservoir is maintained at 350-400lb/sq in by means of the pressurized nitrogen, which is separated from the propane by a plastic diaphragm. The flow of propane to the gas system is controlled by an injector of a variable-displacement type, the displacement being varied in accordance with information obtained from a gas pressure transducer in the gas system. Heat for the vaporization of the propane is provided from the four travelling wave tubes via lithium-compound heat sinks.

The temperature of the gaseous propane would be regulated between 90° and 100°C. When the demands of the system reduce the pressure to a predetermined level, a valve operates to introduce more propane from the reservoir, so that the propane delivered to the nozzles will always be at the correct pressure and the thrusts obtained will be of the correct magnitude.

In the diagram illustrating the reaction system, one channel is indicated for the proposed electronic system. The satellite would be stabilized in pitch and yaw, but would be left free to spin about its axis of symmetry.

Sensing the Horizon

The system would consist basically of sensor and control sections. The sensor section would have an infra-red sensor employing a rotary scanner sensitive only to the Earth's self-emitted radiation, thus allowing the horizon (and hence a local Earth vertical) to be determined.

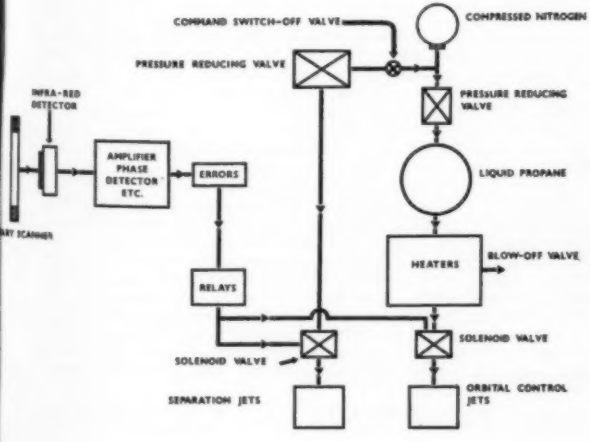
A phase reference generator would provide information on the position of the axis of the satellite and a comparison of Earth vertical and satellite axes. The output of the unit via an emitter follower is an error signal. This signal, which might be positive or negative, is fed to a non-linear controller which sums it until it reaches a predetermined value. At this value a relay is operated which actuates two propane gas solenoid valves, allowing gas to flow to the jets.

The transference of heat in space is mostly by radiation, although conduction will occur within the material of the satellite. The sources of heat to which the satellite is exposed are radiation from the Sun and Earth, and the internal heat generated by the electronic equipment.

The proposed temperature control system would use a series of hinged shutters, the outer surfaces of which would be coated with a white lead carbonate paint with the property of low solar absorptivity and high surface emissivity. The whole of the outer canister surface, as well as the shutters, would be treated in this manner. The shutters are operated by means of the differential expansion property of a bi-metallic strip and, when open, reveal black surfaces with radiative properties of opposite character to that of the white surfaces.

As well as controlling the temperature of the canister, the system must protect the solar cells from excessive heat. This would be achieved by coating the cells with an ultra-violet reflector, probably in the form of vacuum-deposited silicon oxide. In addition, the rear of the panel would be painted black.

Attitude control system for the communications satellite described in the article. This relies entirely on propane-fed reaction jets



Announcing the joint studies in London on February 28: M. F. Vinsonneau, deputy general manager of SEREB (left) and Sir Roy Dobson, managing director of the Hawker Siddeley Group

The satellite structure basically consists of two major parts; the solar cell array and the instrument canister. With the fixed array chosen the total area of solar cells is about 230 sq ft, which is divided into eight panels of approximately 28 sq ft each. Total extended length of the array is about 17ft (see diagram). The general-arrangement view indicates that, in its extended form, the satellite is totally unsuitable for storage in any conceivable upper stage of a boost vehicle.

As indicated in the second diagram, the solar array can be folded so that the whole satellite can be contained in a cylinder about 4ft 6in in diameter and 12ft in length. Although space-environmental conditions would suggest a very lightly stressed structure, launching conditions of perhaps 10g accelerations axially and 1.5g laterally impose more-stringent stress requirements. Thermal radiation effects must also be taken into consideration.

The panels consist of solar cells shingled in groups attached to a lightweight honeycomb base. The hinges are integral parts of the panel structure which is in tension when subjected to the launch acceleration. The erection of the array from the folded position is initiated by the severance of a cable which allows a central compression spring mounted on the canister to extend.

The equipment canister is basically a rigid framework structure with strong points at the lower four corners for attachment to the final stage of the booster. Hinge attachment points for the solar-cell panels are adjacent to the upper four corners. The equipment is carried internally on a central honeycomb frame attached to the four main vertical members.

The satellite is attached to the booster by means of four explosive bolts which form a part of the satellite structure. On connecting the electrical system prior to launch the explosive-bolt mechanism is automatically armed. The outer cylinder enveloping the satellite would be shed possibly after second-stage burnout. The final stage and satellite stage would then be injected into orbit, whence the separation would be initiated. Immediately after separation an explosive cutter would sever the solar-cell-panel retaining cable, allowing the array to extend.

Weight Analysis

A summary of the complete weight analysis gives the following figures for the component parts of the satellite:

Structure of canister	60lb
Solar-cell array with supporting structure	200lb
Wiring and control gear	45lb
Attitude control system including fuel and control electronics	100lb
Batteries	25lb
Aerials, receivers, transmitters and amplifying equipment ...	120lb
Total	550lb

The characteristics of the satellite communications system would include the following: carrier frequency, 6,000Mc/s (ground to satellite) and 2,000Mc/s (satellite to ground); bandwidth, four bands each 2.6Mc/s wide; type of repeater, non-demodulating IF suitable for FM signals; radiated power, 4 watts; number of telephone channels, 100 two-way channels (signal/noise ratio 40dB) or 32 two-way channels (signal/noise ratio 50db).

For the carrier frequencies envisaged, the efficiency of the satellite transmitter was concluded to be best when using travelling wave tubes. The currently available alternatives, transistors or disc-sealed triodes, either were not feasible or had low gain and efficiency at these frequencies.

For a system serving the northern hemisphere, three or four such satellites suitably disposed in 63° inclined orbits should provide "almost a continuous service," according to the Hawker/SEREB report. To give a full service throughout the British Commonwealth and the Communauté Française would need a total of twelve satellites, some of the additional ones having their apogees at latitude 63° South and some in the equatorial plane. The 63° orbits, typically, would have an apogee of 12,500 miles and a perigee of 300 miles.

The European Quick-reference Timetable

SOME RESULTS OF RESEARCH INTO AN AIRLINE COMMERCIAL PROBLEM

BY R. E. ALCOCK
(Chief Research Executive, Air Research Bureau)

IN 1955 the Air Research Bureau was asked by its member European airlines to carry out a comprehensive survey of European timetables. This study was divided into two parts: the first dealt with timetable presentation, both by the airlines themselves and by the official airline guides; the second examined the European schedules from the point of view of co-ordination and their standard and convenience for the travelling public.

With regard to the first aspect, we came to the conclusion that airline timetables varied greatly in quality and that there was a lack of common principle in presentation. For example, symbols indicating days of operation, types of meals served, aircraft types, and so forth, varied considerably.

Turning to the air guides published outside the airlines, we examined very closely *The ABC World Airways Guide*, which has a very wide circulation in Europe, and found a number of deficiencies, including incomplete indexing and a rather irregular order of presentation. As a result of consultations between ourselves and the publishers many of these faults have now been corrected.

Extract from a quick-reference timetable

Days of Service	dep	arr		Class	Air-cra	Transfer point		Class	Air-craft
From BRUSSELS Belgium (BRU)									
VIENNA (VIE)			→ Bfr. 3430 £24.10 $68.60			↔ Bfr. 6175 £44. 2 $123.50			
			→ Bfr. 2485 £17.15 $49.70			↔ Bfr. 4475 £31. 9 $89.50			
	BRU	VIE	THROUGH FLIGHTS						
2. 4.	11 50	14 30	SN 593						
1	12 10	14 50	SN 571						
6. to 31/1	11 50	14 40	SN 795						
7. eff. 1/2	11 50	13 45	SN 795						
6	12 10	16 00	RO 2106						
			TRANSFER CONNECTIONS						
(5)	10 35	14 55	OA 773			Frankfurt	JU 351		
X	10 40	18 30	SN 729			Munich	LH 300		
2. 4.	10 40	14 05	SN 729			Dusseldorf	SK 873		
2	11 20	15 35	SN 725			Frankfurt	LH 602		
X	11 20	16 30	SN 725			Frankfurt	LH 300		
X	11 20	16 55	SN 725			Stuttgart	OS 707		
(1) 3. 4. 6	12 00	17 30	SN 663			Zurich	SR 240		
2. (5) 7	12 00	17 15	SN 663			Zurich	OS 502/52		
(5) (7)	12 00	17 15	SN 663			Zurich	OS 552		
(1) 4	13 35	18 40	EI 640			Frankfurt	OS 402		

Having reviewed the published information available to the public we considered the scheduling aspect; and, in order to explain the weaknesses of European schedules, a few words must be said about the fundamental differences between the European and the United States domestic operation.

In the first place, the traffic volume in Europe is very much lower than in the United States. The land area of Europe is smaller than that of the United States; but, taking into account the separation of certain populated areas by water one can regard the airspace as being comparable. The population of Europe is almost double that of the United States, but there is a higher proportion in Europe occupying rural areas.

One would therefore quite naturally ask why the traffic volume in Europe is only one-sixth that of the US domestic operation. This is primarily due to the fact that the price of the ticket in Europe is very much higher in relation to disposable income. The figures in the table illustrate these points:—

	United States	Europe
Land area (million km²)	7.8	4.5
Airspace (million km²)	7.8	6.7
Population, 1958 (millions)	178	360
No of cities with over 250,000 inhabitants	49	75
Passenger-kilometres per capita	268	26
Average hourly wage-rates (including fringe benefits)	$2.68	$0.73
Average U.S. fare-level per passenger-kilometre	3.61 cents*	4.56 cents†

*U.S. Domestic Trunk. †European scheduled international and domestic.

One can therefore say that on average a United States citizen earns three to four times more than his European counterpart. But, because the European operation is two-thirds an international operation and only one-third domestic, and because international operations involve a severe cost-penalty for the airlines, the fare level in Europe is 26 per cent higher than in the USA. It can therefore be seen that, in terms of the price of the ticket in relation to disposable income, air transport is very much more expensive to the European. Also, as a consequence, operating costs are higher in Europe than in the United States, owing to the smaller scale of operation of individual carriers and the comparatively low traffic-density.

The type of equipment used by European carriers is, generally speaking, the same or similar to that of the US domestic operators, and consequently the aircraft tend to be larger than would normally be required in relation to the traffic volume. Whilst the larger aircraft gives a lower cost per produced unit, it entails a serious commercial penalty. In order to maintain a reasonable load factor the carrier is obliged to operate a large number of low-frequency routes—in fact, the average frequency of service in Europe is about eight round trips a week.

Frequency of service is, of course, an extremely important element in traffic-development and in improving the service offered to the travelling public (particularly on the shorter stages, where rail competition is still very keen); and our study of the European scheduling system brought us to the conclusion that the service to the public could be improved by a better co-ordination of schedules. Where direct flights between European cities were of low frequency there was a need for the advertising and promotion of transfer traffic by connecting flights at intermediate stations on days of the week or at times of the day when direct flights were not operated. This brought us to the concept of the quick-reference timetable.

This timetable (extract above) is on a point-to-point basis, is read horizontally instead of vertically and contains not only direct

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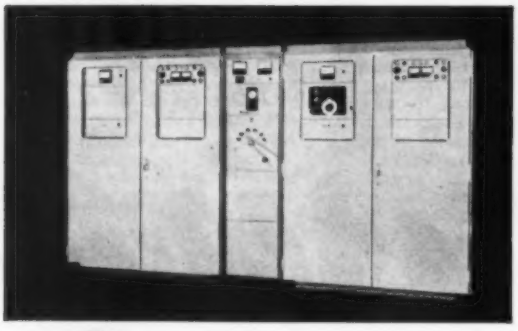

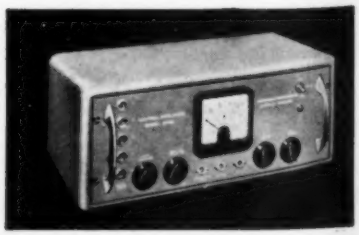

Illustrated left, is a PA 20KVA Power Amplifier; and above, the E501 'g' Control Amplifier.

*

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The European Quick-reference Timetable . . .

Example of a typical vertical table

SN 591 DC-7 C	SN 593 DC-7 C	SN 587 B707	SN 589 DC-7 C	SN 505 DC-7C	SN 593 DC-7 C	SN 795 Super DC-6	SN 501 DC-7 C		SN 571 DC-7 C		
F C Y	F C Y	F C Y	F C Y	F C Y	F C Y	F C Y	F C Y		F C Y		
①	②	④	⑤	⑤	⑥	⑦	⑦		①		
11.50	11.50	11.50	11.50	12.55	11.50	11.50	11.55		12.10	d.	BRUXELLES/ BRUSSEL National a.
×	×		×	×	×	×	×		×	a. d.	FRANKFURT Frankfurt-Main d. a.
13.10 13.40	×		13.10 13.40	×	×	×	×		×		
	14.30 15.10	×		×	14.30 15.10	14.40 15.10	×		14.50 15.50	a. d.	WIEN Schwechat d. a.
19.10 Anka.	19.45 Cairo	15.55 Téhér	19.10 Istanb.	19.15 E'ville	19.45 Cairo	19.50	18.15 E'ville		×	a.	ATHINAI Central Airport d.
									22.35 Léo.	a.	TEL AVIV Lod d.

flights between two cities, but the single (and in some cases double) transfer connections which are also available. The inclusion of transfer flights materially improves the service frequency, and the information is clearly presented. By reference to conventional tables, the finding of suitable connections is a laborious one, particularly for the travel agent. Comparison between an airline timetable and the quick-reference counterpart shows that between Brussels and Vienna the airline offers a frequency of four flights per week. The quick-reference table advertises 41 frequencies per week.

The next problem was to convince the airlines that this was a good commercial proposition, and here there was a fundamental difference of opinion, owing to the fact that the direct flights were the result of bi-lateral agreements between the governments involved, many of whose national carriers were primarily interested in Fourth and Fifth Freedom traffic, whereas the transfer flights were, in many cases, an advertisement for Sixth Freedom traffic. However, these difficulties were overcome by an agreement that the through flights should be published at the top of each city-to-city table, and the transfer flights below in a lighter type-face.

It now became necessary to sell the idea to a publisher. Negotiations were opened with *The ABC World Airways Guide;* and eventually (after some hesitation, which was only natural as they were taking the commercial risk) they agreed to publish a European timetable in this form as a section of their monthly Air Guide. Publication began in December 1958 and has continued uninterrupted since.

It was realized at the outset that some form of mechanization must be used to facilitate the production, and to date the Air Research Bureau has been producing a monthly tabulation of all European international direct flights in co-operation with IBM, while the airlines have been constructing the transfer connections, with the tabulation as a reference document, and passing them to the publisher.

Most new ideas in science and commerce (the jet engine and radar are good examples) are thought of by more than one person at the same time, and in the United States American Aviation Publications were working on similar lines. This resulted in the publication of the US domestic quick-reference timetable, which is becoming very popular on the other side of the Atlantic. However, there are certain marked differences in presentation compared with its European counterpart. In particular the former does not include all transfer connections (which are, of course, much less important on the American continent, owing to the much higher frequency of direct flights).

After two years of publication it was decided between ourselves and the publisher that it was necessary to find the public response to this new form of timetable, and a questionnaire survey has recently been carried out. The results were extraordinarily positive and consistent, both as regards European and non-European subscribers and different types of subscriber—airline, travel agent, commercial firm or individual. The opinions expressed by the readers were (a) that the quick-reference section was extremely valuable, (b) that the present form of presentation met their requirements, (c) that the geographical area (which had been confined to the United Kingdom and continental Europe) should be extended, and (d) that in the extension, consideration should first be given to the Near East and the whole of the Mediterranean seaboard.

Before extension can take place it seems probable that the entire production will have to be mechanized. The publishers will then have a bank of information on all European scheduled services on punched cards, with the great flexibility which this allows. Amendments to schedules can be actioned immediately upon receipt of information from individual carriers and transfer flights can be worked out or amended by the computer, thereby ensuring a high degree of accuracy.

Apart from its value in the construction of the quick-reference guide the information may find its application in a variety of ways useful to carriers individually or collectively. Indeed, it may be possible to use this data not only for the practical job of improving the presentation of timetable information, but in further research into questions of service frequency and improving the co-ordination of schedules between airlines; in both these aspects certain weaknesses in the present service offered may come to light.

There is no doubt in our minds that this form of timetable is a vast improvement upon the vertical timetable as a sales tool, particularly to airline and travel agents' booking offices. The timetable is the sales catalogue of the airlines; it gives the nature of the commodity for sale, its quality in terms of comfort, speed and price, and its availability in place and time. The presentation of this information *in toto* and in the clearest possible manner is of fundamental importance; and, in Europe, owing to the low service frequency on many routes, it is necessary to have available all the information concerning all possibilities of air travel between two cities, grouped together so as to offer the widest possible coverage of the market.

We are therefore confident that this timetable will continue to grow in popularity and will assist the airlines and their agents in selling the airlines' product to, we hope, an ever-increasing number of air passengers.

MATS AT MILDENHALL

MILDENHALL is famous in aviation history as the starting-point of the England - Australia air race in 1934, shortly before it became an RAF station: but for thousands of US Armed Forces personnel and their dependents who travel by the Military Air Transport Service, this airfield in the Suffolk countryside is now the gateway to (or exit from) Europe.

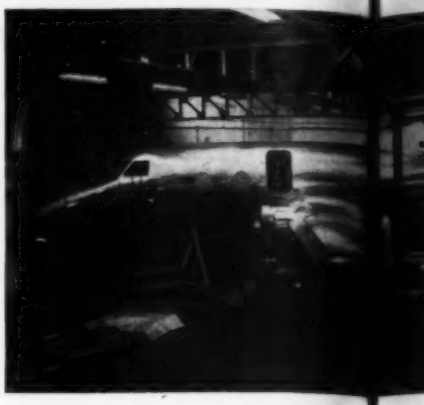
It is just a year since Mildenhall took over from Burtonwood as the centre of MATS operations in the UK, and in that time some impressive statistics have been accumulated: some 65,000 passengers and 16,000 (US) tons of freight have been handled at the airfield since March 1, 1959, and there have been 4,000 movements by MATS aircraft. Scheduled services are operated between Mildenhall and the United States, France, Germany and North Africa, aircraft using the airfield including C-121s, C-124s, C-130s and C-133s.

The station is headquarters for the 7513th Air Base Group (USAFE), USAF, which sees to the ground handling of cargo and passengers. Computer equipment is used for the calculation of manifest details and records, and passenger facilities include a fully equipped terminal building, cafeteria and transit hotel. Buses take UK-bound personnel to their destinations at other USAF bases. Dollar currency is used exclusively for goods and services.

Mildenhall is also the headquarters of No 3 Group, Bomber Command. It was used as a bomber station throughout the war (F/Sgt R. H. Middleton won his posthumous VC on an operation from there) when Lakenheath, only five miles away and also now a USAF base, was its satellite airfield. Mildenhall is to be "at home" for both stations on the next US Armed Forces Day, Saturday, June 17.

Messier undercarriage for the Dassault Mirage IV. Subtle geometry was necessary in order to fit the leg into the thin wing. The bogie retracts into the fuselage

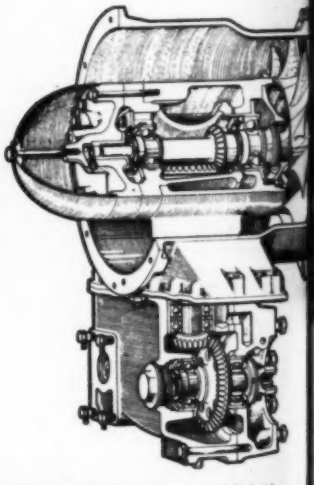
Right, the prototype Potez 840 shortly before it was dismantled and taken to Toulouse for completion and first flight in April. Far right, the inward-facing 24-seat and forward facing 16-seat layouts in the mock-up cabin



COLLECTION

NEW FRENCH AIRCRAFT AND ENGINES IN

The little Gardan GY.80 Horizon has just successfully completed official flight trials. It is a sprightly little four-seater with a Lycoming 150 h.p. engine

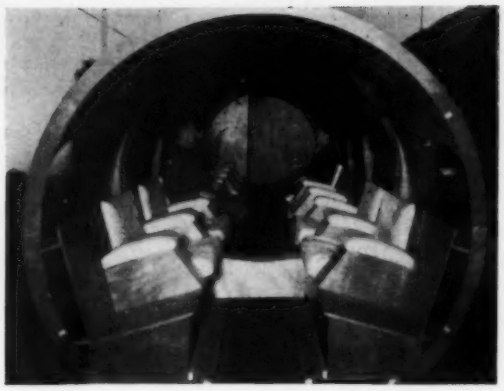


AMONG what might be termed the spring collection of new French aircraft are those illustrated here. Three pictures at the head of the page show the Potez 840 (four Turboméca Astazou turboprops), which has now been transported from the Argenteuil factory to Toulouse for final assembly, and views of the mock-up, showing the inward-facing 24-seat and forward-facing 16-seat layouts. The 840, which is to fly in April, was described in *Flight* for July 22, last year. At top left is the main undercarriage, a remarkable assembly by Messier, of the Dassault Mirage IV-01. The aircraft is now flying again, this time equipped with a very broad radome beneath the fuselage.

Above left is the first Gardan GY.80, now named Horizon, which will have a Lycoming 150 h.p. engine with fixed-pitch or constant-speed propeller. The first Horizon has virtually finished its flight trials, with great success, and the second is taking shape on the production jigging used for the prototype. Many production parts have already been assembled in the Hurel Dubois factory at Villacoublay and arrangements for full production are nearing completion. The Horizon is exceptionally attractive and should be a strong competitor in the international market. It was described in *Flight* for January 6.

The cut-away drawing illustrates the Turmo IIID for the Breguet 941 Intégral—one of the first such views ever published—and below it is a picture of the 941 fuselage passing through the Rambouillet forest on its way from Paris to the new assembly hall at Toulouse. The first flight is due in April. Flight tests with the 940 prototype continue and remarkable performance is being achieved. Pitch of the outboard propellers is set fine and differentially varied to assist lateral control during the approach. All four engines run at full power and reverse thrust from all four propellers is available instantly after touch-down. The transmission of the 941 is to be considerably simplified. Notable features in the engine are the transonic axial and centrifugal compressor stages, a feature of all the late Turboméca turbines. There are two turbine stages followed by the power turbine driving into the reduction gear—also to be greatly simplified in the 941. BEA, Air Inter, the US Army, NATO and the Swedish army and airlines are interested in the 941, 942 and 945; and two of the last-named are to be ordered when the 941 has shown its paces.

The twin-Turmo, four-propeller 945, is intended to carry commando parties to distant points, land them and give fire support with guns and missiles and then withdraw the party again. This is an extension of the battle helicopter concept which has proved highly successful and lethal in the North African fighting.



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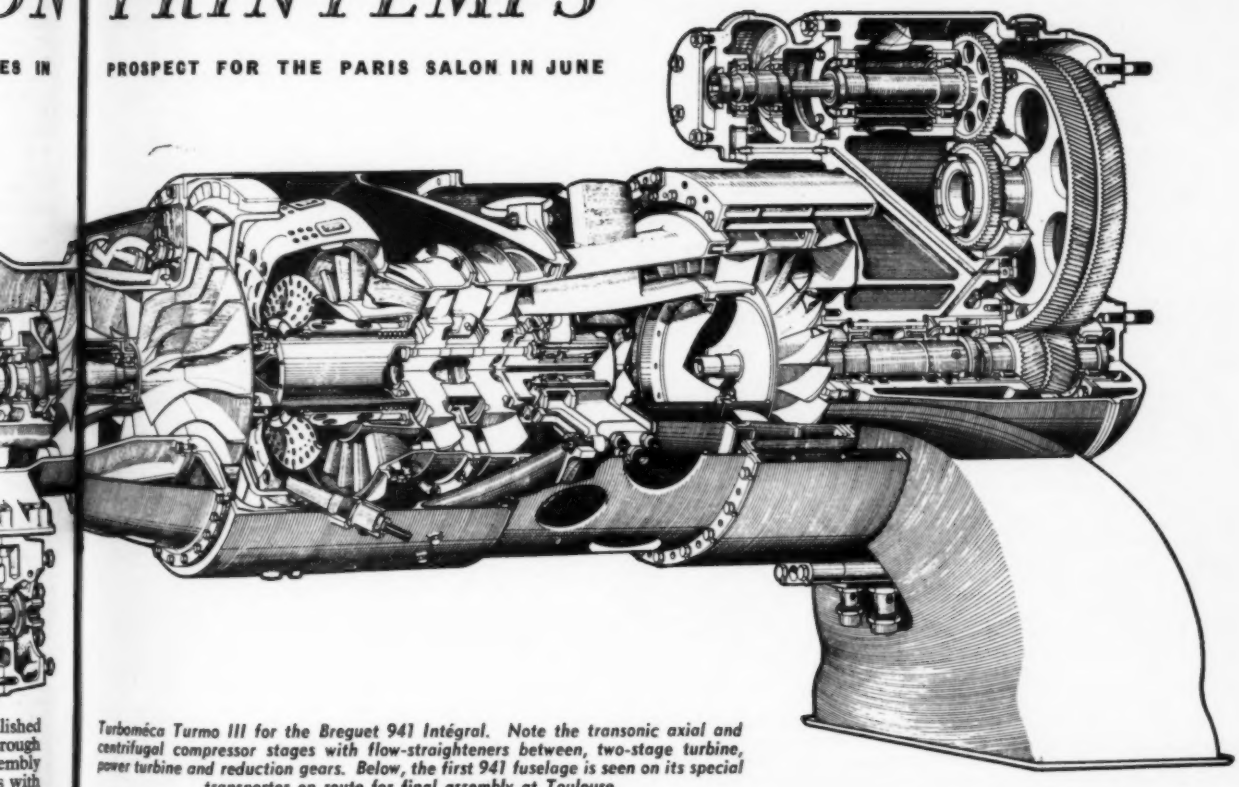
PROSPECT FOR THE PARIS SALON IN JUNE



Turboméca Turmo III for the Breguet 941 Intégral. Note the transonic axial and centrifugal compressor stages with flow-straighteners between, two-stage turbine, power turbine and reduction gears. Below, the first 941 fuselage is seen on its special transporter en route for final assembly at Toulouse

AIRCOUPE in the Air

BY MARK LAMBERT

No 140 of the Series

YET another American light aircraft, the Aircoupe, is now available in Britain—and it is another two-seater powered by a Continental 95 h.p. engine. Under various names, the Aircoupe has been made for many years in the USA and production is now in the hands of Air Products Co Inc, of Carlsbad Municipal Airport, Carlsbad, New Mexico. Seven Aircoupes have already been imported into Britain by Thurston Engineering Ltd, of Stapleford Tawney airfield, Essex, who are the sole distributors for Western Europe. Of the seven, one has been intensively flown during the past two months and is about to receive its public-transport C of A. The second is almost ready and the sales prospects for this first batch appear good. The price of the basic aircraft is £3,575 fly-away Stapleford, or £4,200 with radio, gyro instruments, lighting and all mod. con. British instruments and equipment are being incorporated as far as possible in order to reduce the price.

The appearance of the Aircoupe is familiar to a good many people in Britain, for two examples flew extensively here some years ago. The present model is naturally improved in detail; and the two-control system, without rudder bar, has now been made an optional rather than primary control system. The Aircoupe can accommodate its full fuel load of 20 Imp gal (in three tanks), two people, light radio and 75lb of baggage and will then cruise at 109 m.p.h. indicated. The full 90 h.p. can be used, with 2,475 r.p.m., to give a best TAS of 120 m.p.h. Thorough investigation in this country has shown that the aircraft will not spin, and its stall is barely noticeable. Very limited rudder control and fairly limited elevator have made this possible, but the consequent restriction in control effectiveness has not made the aircraft unpleasant to fly. Perhaps the most remarkable feature of the Aircoupe is that, although it follows the American tradition of rather mushy control, it is really simple to fly and is manageable in very poor conditions. I flew it last week for almost two hours in a rough wind from the really appalling turf surface of Stapleford. It behaved extremely well, received a tremendous beating from ruts and bumps without a murmur, and took off and landed in an almost 90° cross-wind without the slightest difficulty. A most important point in its favour is its low wing and near-bubble canopy; you can really see all round you in any flight condition and on the ground.

To get in, one opens the Aircoupe rather like a Gladstone bag by pulling the two sliding roof-panels down into the sidewalls. Little cloth flaps fold back over each seat to make a good footstep and there is plenty of leg room by virtue of tiny rudder pedals. The feet stay close together and full pedal-travel requires only ankle movement. Across-the-shoulder space and head-room are just adequate. You can fly with the roof open.

There is a vernier throttle, and mixture, carburetter and cabin heat controls, and a ventilator. The aileron wheel turns no less than 180° in each direction and the ailerons cover almost the whole trailing edge. There are no flaps. Each aileron moves up a lot, but hardly at all down. The elevator is sharply cut away in the centre, and fins and rudders are very small. Turns almost about one wing-tip are possible on the ground, thanks to light nosewheel steering; and very effective wheel brakes are jointly (non-differentially) operated by a single stout lever between the seats. There is a virtually invisible drum gauge for the two wing-tanks in the port wall and a float-and-wire gauge for the centre tank on the coaming. Engine starting is conventional and easy, as is usual with the Continental. Noise-level is fairly high, but cabin atmosphere can be very effectively controlled.

Take-off technique is to hold the wheel hard back all the time, with full nose-up trim as well, until the aircraft rotates slowly and unsticks at about 60 m.p.h. Back-pressure is then released and the climb at about 65 m.p.h. is steep, but not very rapid.

Cruising at about 95 m.p.h., the Aircoupe handles well enough, although it tends to snake in rough air. Reasonably good turns can be made with either rudder or aileron alone and trim-changes for speed and power are normal and progressive. The trimmer is really useful only for cruising settings and complete circuits can be made with it in any position. Control in turns distinctly recalls the early intentions of the two-control version. Most noticeable is the severely restricted rudder control. At about 70 m.p.h. it is virtually impossible to side-slip without swinging the aircraft hard into a brief skid, but it then straightens-up again almost immediately. Shortage of rudder is also noticeable when kicking-off drift for a cross-wind landing; but there is just enough, and judicious use of aileron makes things surprisingly simple. Aileron control feels marginal in very rough air until one learns to use the incredible wheel-travel available. But despite these initially off-putting symptoms, the Aircoupe definitely grows on one and has great charm. Other pilots have had the same experience.

I greased it on almost every time at Stapleford, when Cubs and other types were wallowing and ballooning around in no uncertain way. Steering and braking on the ground were excellent and the ride remained level despite the vicious potholes. The stall is really a loss of elevator control at about 45 m.p.h. indicated (58 m.p.h. actual), followed by very slight phugoids, which may or may not damp right out if the wheel is kept firmly back. A sharp round-out with power off is possible at 60 m.p.h., but not at 50 m.p.h. indicated. Power-on landings can be made very slowly, but require a shallow approach angle. Approach speed is not easy to hold, but the glide angle at 65 m.p.h. is more than it seems, because the nose sits fairly high.

For an hour I just cruised around listening to the BBC on an MF receiver and playing with the Superhomer on Clacton and London VORs. The heater was on and I was relaxed and comfortable. In short, the Aircoupe is a restful little machine. For a club pilot likely to be caught in bad weather, but still wanting a simple runabout, it is in my view the best American type yet to reach the British market.

AIR PRODUCTS AIRCOUPE
(One Continental C-90-12F giving 95 h.p.)

Span, 30ft; length, 20ft 2in; wing area, 142.6sq ft; empty weight, 900lb; gross weight, 1,450lb; power loading, 16.1lb/h.p.; wing loading, 10.17lb/sq ft; fuel tankage, 20 Imp gal.

Performance: VNE, 144 m.p.h.; max manœuvring speed, 108 m.p.h.; best cruising TAS, 120 m.p.h.; stalling speed, 58 m.p.h.; service ceiling, 15,500ft; take-off run 500ft; landing run, 600ft; range, 500 miles.

The deep-bellied little fuselage of the Aircoupe accommodates two in comfort. Note the tough undercarriage and the small tail surfaces. Radio and full night lighting are optional extras.

Lord Douglas, Chairman of B.E.A. says:

"Last year our passenger traffic rose 20 per cent —which is almost half as much again as the world average.
This most satisfactory expansion owed much to the further fare reductions which we were able to introduce and to the appearance on the routes of B.E.A.'s first pure-jet aircraft, the Comet 4B, which entered service in April".

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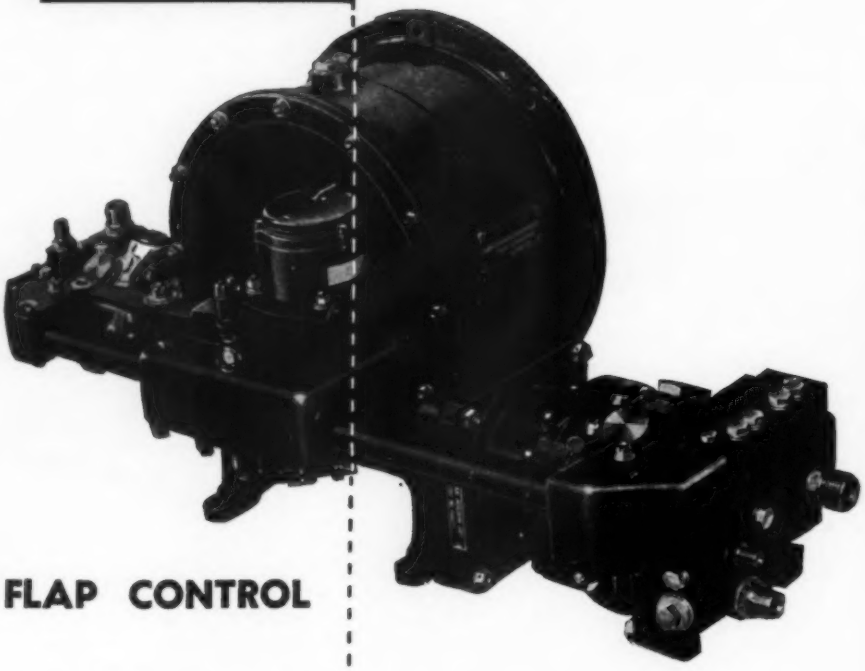

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Attack and Defence

—IN THE COMMONS: MINISTERS AND MEMBERS DEBATE THE WHITE PAPER

THERE was little love for the 1961 Defence White Paper in the two-day Commons debate last week. From behind the Treasury Bench as well as from the Opposition ranks before it, there came a steady stream of doubt and criticism.

In his opening speech the Minister of Defence elaborated a point which was well made by Sir George Edwards in an interview in this journal three weeks ago. Sir George asked for more consistency of purpose and planning: let us think a little longer about a project (he said) but, having decided upon it, let us carry it through. The White Paper itself talks of making a forward estimate for the next five financial years. The Minister said that it was quite illogical to have a year-by-year budgetary process when we were dealing with projects for which a five- or seven-year time-scale was normal. He rightly said that it presented industry and research with an impossible task if decisions were taken on a yearly basis.

But as one listened to the quite serious challenge to some of the basic assumptions of present policy the prospect of keeping to a course laid down five years ahead seemed doubtful indeed.

Just what scope there is for change is exposed in Paragraph 8 of the White Paper: "The primary purpose of our defence policy is, therefore, that it should protect us, our allies and our friends, against the whole spectrum of possible aggression and military threats, from the small local action which might be the beginning of larger and more dangerous adventures through 'nuclear blackmail' to nuclear war."

Mr Watkinson, at the outset, endeavoured to meet this anxiety when he acknowledged that the task of keeping up with two industrial giants meant that we had to be selective in our effort. This, he said, we were doing successfully. In the Navy our special contribution was in relation to anti-submarine warfare and in the operation and control of aircraft carriers. In the Army we were producing, and continuing to develop, the best family of tank guns and tanks in the world. In the RAF, "We are clearly right to make contribution by means of aircraft; we have already contributed much, and by aircraft I also mean aero-engines. In the TSR.2, for example, we have a project which at present is ahead of anything else in the world."

It was a former Conservative Minister of Supply, Mr Aubrey Jones, who from his place above and behind his former Ministerial colleagues made the most telling criticism. He claimed that the Minister of Defence and his colleagues had not yet understood the full implications of what had happened since the famous White Paper of 1957. The 1957 policy was an attempt to cover the whole gamut of weapons appropriate to an independent State, whilst dropping prematurely because we couldn't afford it, the manned aircraft in favour of the rocket. "We are witnessing," said the ex-Minister, "the visible collapse of that aspiration after independence, and what worries me is that as yet I see no clear discernment of what we are to put in the place of collapsing independence." His reasoning was that we were now re-substituting the manned aircraft for the rocket; that apart from the free-falling bomb, the only British missile to be fitted to these aircraft would be Blue Steel, which certainly could not take us forward for ten years. Skybolt would not give us complete independence and, in any case, was under suspicion.

Skybolt "Abortive Expenditure"

Mr Jones construed earlier remarks of the Minister to mean that we were considering yet another British weapon as an insurance against the possible failure of Skybolt. "I cannot imagine," he went on to say, "a greater folly than to cancel a weapon which is reasonably one's own after an abortive expenditure of £100 millions and to rely on a weapon from elsewhere, and then to take out an insurance policy against the possible failure of that weapon. This, to my mind, would be sheer madness." He maintained that, despite the increased powers of the Minister of Defence, and despite the existence of the Chief Scientific Adviser, the objective advice on long-term defence planning remained deficient—the crux of our present problem.

The move away from the 1957 nuclear philosophy has highlighted the man-power position, and almost without exception the Conservative critics claimed that, if our conventional forces were to be adequate, selective conscription was inescapable.

Mr Nigel Birch, a former Air Minister, thought it was "right and wise that we should go for selective service." Viscount Lambton said that because it was almost impossible to manage with the numbers of men at our disposal, we were "running the risk of putting our conventional forces in personal danger." Mr Hall, who wound up for the Government side after the first day's debate, put as his personal opinion that as all, or nearly all, of our allies, and our potential opponents, had conscription, it was going to be difficult to justify our own refusal to have it.

If a force has insufficient men it is, of course, especially important to have them mobile, and the Air Minister, Mr Julian Amery, devoted part of his speech to the growth of Transport Command. Having gone to the War Office shortly after the Suez operation, he said, he was particularly conscious of the transport position then obtaining. Since 1957, with Britannias, the strategic-lift capacity has been doubled. Within the theatre—from the main base to whatever operational base might in future be used—we had doubled the Beverley force, and greatly increased the numbers of Hastings in the tactical role. In tactical transport we had brought in about 30 Twin Pioneers, and helicopters were beginning to arrive in reasonable numbers. Moreover, new skills had been acquired and No 38 Group of Transport Command were specializing in the kind of helicopter and parachute operation which had been successfully undertaken by the French Army in a guerilla and insurrectionary situation. He rejected suggestions that we could lift men but not equipment.

I do not myself recollect a post-war defence debate in which both the increasing importance and the inadequate equipment of Transport Command have not been stressed. Though there is the reserve of our civil air fleet in time of real emergency, it is surely not too much to hope that this one certain requirement, in a whole spectrum of uncertainties, may one day be met. No participant in the debate disagreed with the claim that *something* had been done for the Command since the time of Suez; but no one said it was enough.

Question of Vulnerability

The Air Minister also dealt with doubts expressed about the British strategic striking force. There was the question of vulnerability. It was the Conservative Member for Malden who said it was unfortunate that, only a few days before the case for the V-bomber was debated, we should have released claims of the Lightning fighter's capacity to catch any current bomber. Was is logical to assume, asked Mr Harrison, that the Russians would not have a fighter equally as good in ten years or in ten months?

Mr Amery's view was that the threat today was mainly from manned bombers, and in that time-scale there was plenty of time to take off and to bring the Thor missiles to a state of readiness. As the missile danger grew, the warning times would drop fairly sharply and steps were already being taken to counter it.

The Air Minister recollected that at Farnborough the V-bombers scrambled in 1min 20sec, and that, he thought, gave them more than enough time to get off the ground and away from the area of blast. The V-force, he said, "will be kept on the basis of plans announced for avoiding destruction on the ground and reaching its target, and it will be an effective nuclear striking force under our control, for ten years ahead."

The announced plans, of course, include the change, as the decade advances, from the free-falling bomb to a missile system, first Blue Steel and then Skybolt from the air and the sea-based Polaris. There was much probing from the Opposition about the exact position as regards Skybolt. Mr Amery said that it was necessary to get the position quite clear. The weapons would be sold to us outright, and they would be fitted with British nuclear warheads under our exclusive control. The suggestion that the United States would repudiate agreement would, said the Minister, be treated with the contempt it deserved. When he was interrupted by Mr Brown and asked if there was in fact an agremeent covering more than the terms of our participation in development, Mr Amery said he would leave the matter to be cleared up by his Rt Hon Friend.

Winding up the debate, Mr Watkinson gave his considered reply. He said we had a clear option on Skybolt, which was "fully compatible with the Mark 2 V-bombers." Further, he had signed a memorandum of understanding with the previous US Secretary of Defence, which gave the weapon to us with no strings "only if it is finally developed and fitted to B-52s." After this statement the Defence Minister immediately asked himself the rhetorical question "What other options have we?" The reply was "the remarkable new aircraft the TSR.2 . . . a weapons system in which the pilot merely monitors the system . . . a strategic and a tactical role . . . two years ahead of any other weapons system of its kind in the world."

One wonders what is being put into that forward estimate for the next five years. What is the budgeted allowance for man-power—voluntarily recruited or selectively conscribed? For Skybolt? For other missile systems? What weight can be given to the possibility of disarmament? What will be the political control of NATO? It is an interesting speculation—estimated by one of the best defence debates for a long time.

FRANK BESWICK

This blessed plot . . .

***WITH GRATEFUL** acknowledgement to the Royal Aircraft Establishment "Flight" is here able to present a picture of uncommon interest. It will, we believe, give pleasure and instruction to a great body of readers, especially those familiar with Southern and Eastern England. Such is the detail visible even on* this small reprod individual buildi clearly discernib flying of the pho

This small reproduction of the 8ft x 4ft mosaic (built up from 250 pictures) that individual buildings in London, such as the new Shell block at South Bank, are clearly discernible. Very great skill and patience were required both in the flying of the photographic Canberra and the piecing together of the mosaic. London Airport, near the big Staines reservoirs, provides a ready reference-point. Some sorties were unsuccessful owing to haze or cloud build-up, but eventually full cover was obtained in two flights at 45,000ft. The mosaic will be seen at the Ninth International Congress for Photogrammetry in London this year

Crown copyright

Straight and Level

THE new Paris Orly terminal is a masterly reconciliation of the sometimes conflicting requirements of engineering and æsthetics. But about a hundred yards away is an unsightly cluster of huts, *à la* London Airport North, and a big, iron hangar.

Just to keep the record straight, the airport authorities have not, as has been done at LAP North, posted up a few barely noticeable notices of apology. Instead they have painted across the hangar in enormous yellow letters the words DEMOLITION FIN 1961—to be demolished at the end of 1961.

This piece of public relations is typical of energy, efficiency and breadth of view with which the whole Orly project seems to have been tackled.

● "Okay, so you make the best airplanes in the world. Okay, so we fill the skies with ours."

● It is the opinion of the Government that aft-facing seats give passengers an extra margin of safety (see *Flight*, May 22, 1959, page 727).

The same Government prefers British Servicemen and their wives and children to be transported in aft-facing seats, and RAF Transport Command has aft-facing seats as standard. Meanwhile, the RAF Institute of Aviation Medicine thinks that aft-facing seats are safer (*Flight*, Oct. 16, 1959, page 408).

I find it difficult to wax enthusiastic about this latest manifestation of airline quality competition. I am sorry, Canadian Pacific, but (as Her Majesty remarked) we are not amused

It is now recommended in the CAB report into the Eastern Air Lines Electra accident at Boston that passengers should face backwards. Many of the Electra's passengers, it is established beyond doubt, were killed when their heads struck the seats in front of them, or the meal trays in those seats.

I think you may be wondering, as I am, how much longer passengers are going to be deprived of the real chance of survival that aft-facing seats provide in survivable accidents. It is up to governments. So far they, our own Government included, have shirked their duty to the public.

● Admiral Sir Matthew Slattery, chairman of BOAC, said in Sydney the other day that London, "oldest and still the most important commercially of all long-haul air-routes to Australia," would, with the advent of the supersonic airliner, be only "12 or 16 hours away."

Sir Matthew is always careful when he talks about supersonic airliners (which always guarantees BOAC some headlines) to be responsibly cautious in his remarks, as he was on this occasion.

But why even *talk* about supersonic airliners? Are there not many other subjects of much more immediate interest for a responsible airline chief to hammer away at?

The supersonic airliner was the subject of the Admiral's first public statement as BOAC's chairman. I hope that he will now lay off the subject for at least five years.

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My dear Bacon,

Gloria and I would be charmed if you and Heather could join us at my flat for drinks next Tuesday evening at about six o'clock. Just a social occasion you know—though it so happens that I have heard something that might interest you. I hear that a Certain British Aircraft Firm has been telling your staff that our SA.421 is having serious aerodynamic development troubles, and other such nonsense (it's all quite untrue of course). Well, my chaps have managed to dig out an interesting fact or two about their competitive machine—you know the one I mean. Anyway, shall we see you on Tuesday?

By the way, did the case of whisky and the sable for Heather arrive safely? Do let me know if they didn't so that I can arrange for replacements if not. And that theatre date you couldn't manage, how about fixing it up definitely now? I know how busy you must be sorting out all the conflicting claims of this great industry of ours, but a little relaxation should do you no harm. May I give you a ring sometime?

Yours ever,
Blackie

One gathers that this motel in the Laurentian Mountains, north of Montreal, is named after the missiles on a nearby site. The Laurentians are a beautiful part of the world—lakes, fir trees, sweeping highways. But alas, these ghastly neon signs everywhere. Thinks: only man is vile, but how vile can he get? How about Fred's Nuclear Cafe? Or The Gay Strontium 90? Or the Electric Chair Kosy Tea-Roome?

● "Copenhagen, February 24, Reuter: An airman who believed jet aircraft fuel could not burn appeared as defendant in court at Haderslev today in a 60,000 kroner (£3,000 sterling) damages suit—because it did burn.

"The fuel spilled while the man was filling a Danish Air Force jet plane at Skrydstrup air base, South Jutland. An argument started among three airmen in charge of fuelling it. Two of the men said the fuel would burn. The third said a match could not light the fuel. 'Look, it will not burn,' he said, and struck a match. But it did, and the Danish Defence Ministry has now brought a suit against the airman to pay for damage caused to the plane in the fire.

"The court ordered that the airman's name should not be disclosed 'out of regard for his career in the Air Force.' He was considered a 'brilliant soldier' and had been promoted to sergeant since the incident."

● I like this one from the *de Havilland Gazette*—presumably referring to the new book *"DH, An Outline of de Havilland History,"* by C. Martin Sharp:—

"A book is a success when people who haven't read it pretend they have."

ROGER BACON

As a modern anti-submarine weapon, the helicopter is unequalled in range, speed and capability of locating enemy underwater vehicles. Carrying the latest Sonar detecting equipment it can search large sea areas in a minimum of time, and in addition to completing the operation faster it also releases conventional surface vehicles for other duties. The Westland range of helicopters includes two machines which are ideally suited for this purpose; the Wessex I which is turbine powered on order for the Royal Navy and already entering service; and the Gnome engined Whirlwind —a development of the well proven piston engined helicopter of the same name. These helicopters are high-performance machines designed for anti-submarine duties in addition to their other roles of transport, rescue, freight carrying and casualty evacuation.

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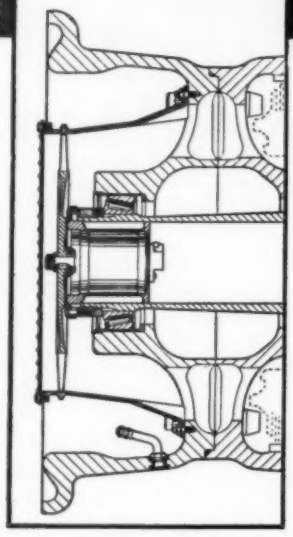

wheel brake cooling ...*fan by* Airscrew

The new air-cooled brake, designed by the Dunlop Rubber Co. Ltd., incorporates a 'built-in' AIRSCREW fan driven by a fractional h.p. electric motor, located in the axle.

This fan not only cuts down cooling time (thus allowing far quicker turn-round*), but also considerably reduces tyre bead and hydraulic fluid temperatures.

Wheel Brake Cooling is only one of many duties undertaken by AIRSCREW fans in modern British aircraft. When *you* have a fan problem, you'll get the right answer faster if you . . .

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* In laboratory tests, 'Turn-round' time (after a normal, fully-braked stop) was cut from 100 minutes to 13 minutes

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Sport and Business

THE BRUNT TROPHY for the greatest gain of height achieved by an undergraduate member of a university gliding club has been won for the first time by a student of Imperial College, London. On all previous occasions since the Trophy was first presented in 1948 by Sir David Brunt, professor of meteorology at Imperial College, the trophy has gone each year to the Cambridge club. On February 24 at the annual dinner of the Imperial College Gliding Club the trophy was handed over to the Rector of Imperial College, Sir Patrick Linstead, by Dr J. W. S. Pringle, FRS, president of Cambridge University Gliding Club and senior tutor of Peterhouse College, Cambridge.

The flight which gained the trophy for Imperial College was made by David Ashford in a Slingsby Skylark 2, and included a gain of height of 13,900ft. In an amusing speech at the dinner, Dr Pringle disclosed that his own past gliding achievements had included soaring over Imperial College and landing a glider beneath the large radio telescope at Jodrell Bank. Unfortunately Jodrell was now just inside the Manchester control zone.

The Imperial College club's activities during the past year were reviewed by Sir Patrick, who is president of the club. Among the main features he mentioned were the period of aero-tow operations at Redhill, with the assistance of the Tiger Club, and the current return to Lasham. The new management at Lasham, the rector noted approvingly, included Frank Irving, lecturer in the College Department of Aeronautics, chairman of the British Gliding Association's technical committee and a leading spirit in the IC club.

An indication of the philosophy of the new committee of management of the Lasham Gliding Society was given at the dinner by the final speaker, Mr David Carrow, newly appointed chairman of the LGS committee. After pointing out the incidental fact that the new committee contained a majority of Cambridge and ex-Cambridge men—Mr. Carrow described this as a Cambridge take-over—the speaker said that it was hoped to regain some of the old atmosphere in which club members were keen to do much of the work themselves; one could not leave it all to the paid staff. This do-it-yourself concept, it was believed, could be very efficient indeed, and it was hoped that the Lasham type of federation of several clubs using a single site might be the prototype for other large centres. Possible sites for other such centres, Mr Carrow suggested, might be in the Doncaster and Carlisle areas.

The health of the guests, who included BGA chairman Philip Wills, was proposed at the dinner by the captain of the IC club, Mr Hugh Browning.

THE FLYING ACTIVITIES of Coventry Aeroplane Club at Baginton Aerodrome are now in the hands of Oxford Aviation Ltd, while the Aeroplane Club is now continuing to operate purely as a social club. The Oxford company will have its own premises and staff at Baginton, and will have Piper aircraft available for hire to business firms requiring executive transport, in addition to providing flying training and aircraft for hire by club members. A Tri-Pacer and a Colt are being added to the existing Coventry club fleet. Oxford Aviation is already operating business aircraft from Birmingham Airport, and plans to operate further flying clubs at other aerodromes in the United Kingdom.

A SALES TOUR by a trio of Jodel light aircraft—the D-117, Ambassador and Musketeer—is being arranged by Rollason Aircraft and Engines Ltd of Croydon. The tour will begin on March 14 and end on April 2, except that an additional flight to Exeter will be made on April 8-9. Places to be visited on the main tour will include Fair Oaks, Portsmouth, Thruxton, Lulsgate, Staverton, Wolverhampton, Liverpool (Speke), Barton, Newcastle, Blackpool (Squires Gate), Yeadon, Derby (Burnaston), Sywell, Ipswich, and Elstree.

THE 1961 FAKENHAM RALLY organized by the McAully Flying Group (previously the Fakenham Flying Group) with the support of the Tiger Club will take place on the weekend of March 25-26 at Little Snoring Aerodrome, Norfolk. Pilots who would like to attend are asked to contact Mr D. Kirkham, 183 High Road, Drayton, Norwich, Norfolk. On this occasion the first aerobatic contest will be held for the prize presented in memory of the late Elwyn McAully.

FIRST BRITISH GLIDING RECORD for absolute altitude in a two-seater glider has been set up by Flt Lt G. McA. Bacon and M/Eng A. Eldridge, flying a Slingsby Eagle from Crosby-on-Eden Airfield, near Carlisle. The height achieved was 20,100ft.

The Tiger Club are hoping to fly four Rollason Turbulents to Moscow for the British Trade Fair in May, providing official approval can be obtained from the Russian authorities. Although the formation flown on that occasion will doubtless be a trifle more open than the one depicted in this excellent photograph by Barry Griffiths, the picture might be considered to be symbolic of the forthcoming flight. We shall hope to publish a similar picture later this year, with Moscow in place of the Surrey countryside as the background to the four Turbulents

Some indication of the savings in both space and weight which can be realized by switching to liquid-oxygen systems can be obtained from this photograph, which shows a 25-litre lox converter on the right and an equivalent stack of gaseous-oxygen bottles on the left

From O_2 to LO_2

LIQUID-OXYGEN BREATHING SYSTEMS FOR SERVICE AIRCRAFT

BY MOLLY NEAL, BSc, DIC, AFRAeS

INCREASINGLY since 1957, front-line aircraft in service in the Royal Navy and Royal Air Force have been using liquid-oxygen breathing systems in place of the cylinders of gaseous oxygen that have been in service in British aircraft for the last 30 years. The equipment is being supplied by British Oxygen Aviation Services. Military aircraft that are being fitted with liquid-oxygen systems are the Navy's de Havilland Sea Vixen, Westland (Fairey) Gannet AEW.3 and Blackburn Buccaneer, and the RAF's English Electric Lightning (all marks), Folland Gnat Trainer, AW.660 Argosy C.1 and Short Belfast.

Probably most people tend to think of liquid-oxygen storage for aircrew breathing systems as a post-war American development; but, in fact, as long ago as 1918 British combat aircraft were carrying liquid oxygen for special high-altitude missions. The problem of provisioning was very difficult in those days, and accordingly high-pressure oxygen gas systems became universal in the RAF after 1930.

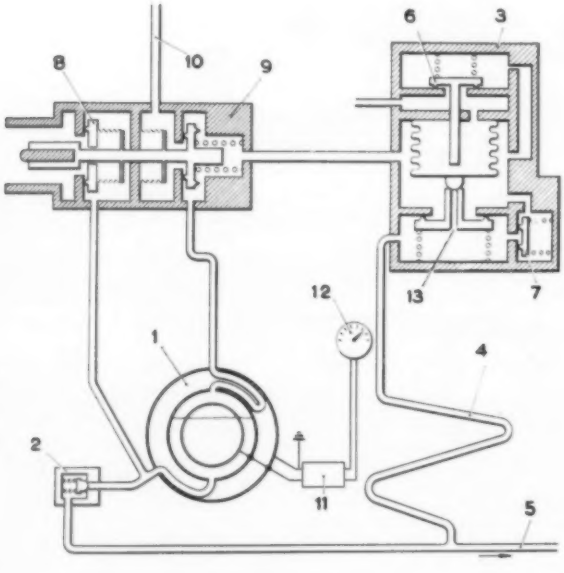
Since World War 2 the volume available inside aircraft has tended to shrink relative to the amount of equipment that has to be put in it; and therefore the saving in weight and space that can be gained by using liquid-oxygen storage as compared with gas bottles had to be re-assessed. The United States was quicker off the mark in developing modern liquid-oxygen systems for aircraft, and today lox breathing equipment is in wide use both in the US Air Force and the NATO air forces.

Many NATO aircraft have lox systems developed by the Aro Firewel Equipment Corporation of Bryan, Ohio. A few years ago, a joint company was formed, British Oxygen Aro Equipment, which works on a fully two-way technical exchange and sales agreement basis. Thus British Oxygen Aviation Services are able to make use of American-built Aro equipment when it suits their purpose—they will, for example, initially be supplying Aro 25 litre lox containers integral with British Oxygen components to make up a converter for the Argosy 660 system—and they are the overhaul organization for Aro Firewel Equipment Corporation installations in Europe. At the same time, the Aro Corporation are kept informed on British research and developments.

The lox equipment being installed in British combat and trainer aircraft is, however, entirely designed and made by British Oxygen Engineering Ltd at Harlow, Essex. This company have unusual resources for development, in that they can call on the services of British Oxygen Research & Development Ltd for a wide range of fundamental data—in particular, they have made use of the metallurgical and processing knowledge of the group research company. In addition they have their own development laboratory, equipped with three wide-range temperature chambers, one providing for temperatures from −75 to +100°C and altitude up to 100,000ft, with humidity variation and provision for injecting live steam into the chamber at −65°C to simulate snow and ice. A decompression chamber allows for testing human specimens at altitudes up to 100,000ft, and there is a large vibration rig and a centrifuge for testing breathing equipment at accelerations up to 25g.

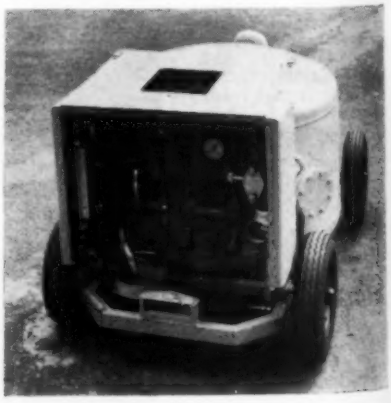
On single-seat aircraft, a 3½-litre vacuum-insulated liquid oxygen converter supplies the pilot's needs; this contains the same amount of oxygen as nearly four standard 750-litre high-pressure gas bottles. In multi-seat aircraft such as the Gannet, Sea Vixen and Lightning T.4, two 3½-litre converters each feed one crew member's demand regulator, but an automatic cross-feed arrangement comes into action should one converter supply fail.

A typical lox system circuit is shown in the diagram. The liquid container 1 is filled, through a fill-and-vent valve, from a mobile airfield lox dispenser which contains liquid oxygen under 50lb/sq in pressure. During filling, the aircraft container is vented to atmosphere; this is automatically brought about when the dispenser hose is coupled up to the aircraft fill-and-vent valve. After filling, when the dispenser is disconnected the vent valve is automatically closed, and the system becomes self-pressurizing.



A basic system: 1, lox converter; 2, liquid check valve; 3, pressure-control valve; 4, pressure-raising coil; 5, supply line; 6 and 7, relief valves; 8, filler valve; 9, vent and build-up valve; 10, vent; 11, gauging unit; 12, contents indicator; 13, economizer-valve port

The 20-US-gal (75-litre) dispenser used by the Royal Navy for the Sea Vixen and Buccaneer



BS

"It is believed that no other single aircraft in the world can match the performance of the TSR 2..."

The Right Hon Harold Watkinson, MP, Minister of Defence, speaking at Weybridge, on Friday, 7th October 1960

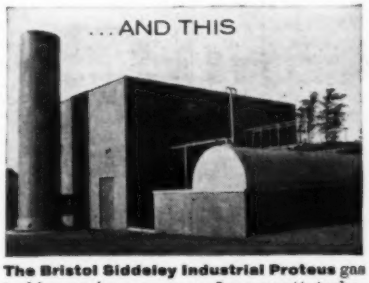
...AND BRISTOL SIDDELEY SUPPLY THE POWER

British Aircraft Corporation have recently received an order from the Ministry of Aviation for a number of TSR 2's.

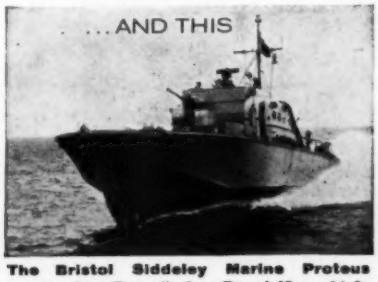
One of the most advanced military aircraft ever to be designed, the TSR 2 will be used in tactical strike and reconnaissance roles with a wide range of weapons, including nuclear. It will: (1) reach twice the speed of sound at altitude; (2) be capable of high subsonic speeds at ground level; and (3) have short take-off and landing capabilities from inferior surfaces.

The TSR 2 will be powered by the Bristol Siddeley Olympus. The Olympus has proved itself in service to be one of the most successful turbojets ever built. Embodying all the qualities essential for the efficient propulsion of a supersonic aircraft, it is eminently suitable for civil supersonic transports.

The Bristol Siddeley Olympus high-thrust turbojet powers the Avro Vulcan V-bomber, spearhead of the RAF's deterrent force.



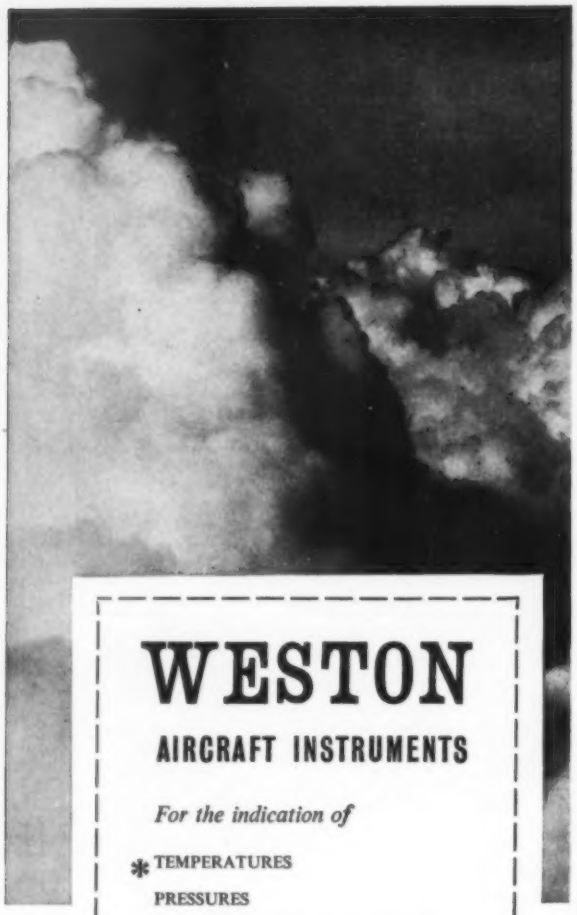
The Bristol Siddeley Industrial Proteus gas turbine engine powers a 3-megawatt turbo-generator which operates unmanned.



The Bristol Siddeley Marine Proteus powers the "Brave" class Royal Navy 96-ft, 50-knot patrol boats.

BRISTOL SIDDELEY ENGINES LIMITED

Central Office: Mercury House, 195 Knightsbridge, London SW7 · Aero-Engine Division: PO Box 3, Filton, Bristol, England · Power Division: PO Box 17, Coventry, England



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SPITFIRE

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BY BRUCE ROBERTSON

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Contents gauging unit, made by GEC

Right, replenishing a Folland Gnat F.1 from a 50-US-gal dispenser at an MoA airfield

the vent pipeline from the converter now being connected to the upper part of pressure-control valve 3. Initially, with the converter at atmospheric pressure, the weight of the lox in the converter overcomes a check valve 2 in the supply line, and lox passes into a pressure-build-up coil where it evaporates and expands. The gas passes through the pressure-control valve and the pressure-balance line back to the converter, raising pressure on the liquid. When the working pressure has built up, the pressure-control valve closes. Any further rise of pressure due to lox evaporating in the build-up coil, no longer balanced by a corresponding pressure-rise above the liquid, shuts the check valve and cuts off the liquid supply.

The supply line is connected, by way of a warming-up coil, to a conventional oxygen-pressure demand regulator. When a crew member inhales through his mask, pressure in the supply line is lowered and the check valve opens, allowing a small amount of lox to flow into the supply line, some passing through the warming-up coil to the regulator and some entering the build-up coil to restore pressure above the liquid.

With the passage of time, the temperature of the lox container inevitably rises; and there is consequently some evaporation from the liquid surface, with a corresponding pressure rise in the system. A relief valve is therefore incorporated in the pressure-control valve to prevent excessive rise; and an economizer valve 13 is also provided which, on demand, allows some of the excess gas to by-pass the pressure-control valve into the supply line so that both gaseous and liquid oxygen are drawn through the warming-up coil to the regulator.

On fighter and trainer aircraft that indulge in aerobatics, a further refinement is necessary that is not shown in the basic circuit diagram. The gas fed from the build-up coil back to the top of the converter is less cold than the lower layers of the liquid oxygen. During inverted flight, this gas would tend to bubble through the cold liquid, and would tend to condense, bringing about a pressure reduction in the converter. It is particularly important to maintain the working pressure on installations where the crew's pressure jerkins are inflated from the lox system, and therefore a "stabilizer" is incorporated in the circuit which passes warm gas to the bottom of the liquid container to equalize the temperature throughout the liquid.

Design Features

It is now appropriate to take a look at some of the design points that are characteristic of British Oxygen lox system components. In designing such a system, the major problem is the efficient insulation of the container, since lox boils at −183°C at atmospheric pressure. As in American practice, British Oxygen have adopted vacuum insulation to cut down convection losses. The spherical container is enclosed in an outer vessel, which is evacuated down to below 10^{-5}mm of mercury. To minimize heat conduction through the solid, very thin wires are used to support the inner container. During development, these support wires were beset by fatigue troubles under vibratory loading; this has been overcome by careful choice of materials, by pin-jointing the wires to the outer casing and seating them in spherical washers on the inner sphere, and by rigorous standards of surface finish to avoid stress-raisers. The fluid pipe- and vent-line which bridge the vacuum are also laid out to minimize conduction, and have walls only 0.01in thick. Using American electro-polishing techniques, radiation losses are minimized by polishing the surface to a mirror finish. By these various means, the loss rate on a 3½-litre converter (which contains 8.75lb of lox) does not exceed about 1lb in 24 hours, i.e., about 12 per cent per day, well below the limit of 20 per cent specified in the military requirement.

Early American converters were made of copper, which is excellent from the point of view of heat-transfer characteristics but which has the disadvantage of becoming brittle at low temperatures. It was customary, therefore, to "corset" copper converters with wire reinforcement. British Oxygen decided that stainless steel was a better all-round choice—and, independently the Aro Corporation came to the same conclusion at about the same time. The British Oxygen converter, however, uses a different welding technique, and has a thinner steel shell (20 s.w.g.).

To avoid problems of carbon precipitation during welding, and resultant porosity, the shell is fabricated by the Argonarc automatic process from an ultra-low-carbon unstabilized austenitic stainless steel. The method of assembling the converter is to mount the inner vessel on its wire support on a flanged ring, to which are welded the two hemispherical caps of the outer vacuum vessel. (For space reasons, the converter for the Lightning intercepter has to be a flattened sphere, whereas the Lightning trainer, Gnat, Scimitar, Sea Vixen, Argosy, Gannet and Buccaneer all have spherical containers.) Bosses to carry the pipes to the inner vessel are also welded on to the sphere, but to attach the flimsy 31 s.w.g. pipes to the bosses a fluxless brazing process has been adopted. This avoids any possibility of flux deposition which could have disastrous effects in maintaining vacuum. Incidentally, to ensure vacuum preservation, the whole assembly operation is carried out in a "super clean" assembly area; all parts, after electro-polishing, are sealed in argon-filled polythene bags and assembled under conditions of surgical cleanliness.

Contents Gauging

Probably the most individual feature of the British Oxygen equipment is the contents gauging method that they have developed, in conjunction with the General Electric Company Ltd. As they were catering for fighter aircraft, it was essential that the oxygen content indication should remain accurate regardless of aircraft attitude. The usual vertical capacitance probe is not ideal for this purpose, and a simple and elegant solution was to adopt a spherical probe which would cover the same surface area of liquid whatever the attitude of the aircraft. The electrical part of the installation, provided by GEC, consists of a compact, lightweight, transistorized pack incorporating a capacitance-bridge circuit, oscillator, amplifier, and voltage stabilizer—all in a space measuring 4½in by 2in by 2in. The indicator is arranged to provide a positive failure indication. In the event of a broken circuit, the indicator needle will fall below "empty": if there is a short circuit, it will travel beyond "full."

All valves in the British system are compact standardized units. The main development problem here has been sealing, since, at the very low temperatures prevailing, most sealing materials harden and are useless. For this reason, British Oxygen have adopted knife-edge and plate metal-to-metal sealing. On some later marks valves and seats will be sprayed with p.t.f.e.

Now, turning briefly to the new RAF transport aircraft: British Oxygen Aviation Services have been awarded the contract for fitting out the AW.660 Argosy C.1 [fully described on February 10—Ed.] and in this case they propose in the first instance to use American-built Aro 25-litre converters. The reason is that the Aro equipment is already in production and available at short notice whereas there has hitherto been no demand for this size of converter in this country. All the valves, however, will be made by British Oxygen. Later, as they become available, 25-litre containers produced at the Harlow works will be phased in. One 25-litre converter will supply the crew of six, through individual demand regulators, and in addition will supply four stretcher casualties through a continuous flow regulator, throughout a

From O_2 to LO_2 . . .

complete long-range flight with a duration of up to six hours.

For the Short Belfast, the requirements are to supply a crew of 12 for a considerably longer duration. One solution to this is the use of two 25-litre converters each supplying six pressure demand regulators, with automatic cross-feed in the event of failure of one supply.

Provisioning Airfields with Lox As a corollary to lox breathing equipment in the aircraft, it is clearly essential to provide supplies of liquid oxygen at the airfields from which the aircraft will operate. British Oxygen Aviation Services have for some time supplied airfield lox provisioning equipment both to the NATO forces and to USAF stations in the United Kingdom.

Standard airfield storage equipment is a 500-gallon cylindrical storage tank, vacuum insulated. On these large tanks, effective insulation is more easily achieved than on the small converters used in aircraft, due to the better surface/volume ratio, and the loss rate is less than 0.8 per cent per 24 hours. It is intended to produce units with a powder insulant for certain applications. On NATO and USAF airfields, a 50-US-gal (185-litre) vacuum-insulated dispenser mounted on a wheeled trailer is charged from the storage tank through an insulated hose with self-sealing couplings.

The dispenser, designed to a NATO specification, is used to fill the aircraft lox converter, one end of the filling hose being plugged into a bayonet connection on the aircraft, which operation automatically opens the vent valve of the aircraft lox system. The working pressure of both storage tank and dispenser is 50lb/sq in.

For the British forces, the same type of storage tank will be supplied. Incidentally, it can be carried in the freight hold of a Beverley aircraft. On the other hand, the Royal Navy find the 50-US-gal dispenser too large for convenient below-decks handling, and accordingly have standardized on a 20-US-gal (75-litre) dispenser with a maximum height of but 3ft, and likewise mounted on a wheeled chassis. A number of these smaller units have also been ordered by the RAF. Hoses and couplings for the USAF, NATO, RN and RAF are all interchangeable.

THE INDUSTRY

English Electric's Year

REFERRING to English Electric aviation activities in his address to stockholders (published in advance of the annual general meeting on March 25) the chairman, Lord Nelson of Stafford, says that the new grouping of companies forming the British Aircraft Corporation "has engendered the warmest collaboration at all levels." The Government, he comments, has confirmed the need for advanced versions of Bloodhound and Thunderbird; development of Blue Water "continues to make excellent progress."

Lord Nelson refers to the design study contract awarded to BAC for a supersonic airliner and adds that "a substantial effort is being devoted to the development of new civil aircraft." Commenting on the affairs of the English Electric subsidiary D. Napier & Son Ltd, he says there was no improvement in its results for 1960; a total deficit of £1,521,540 has been absorbed in the group accounts. Despite this and other adverse factors, group profit after taxation is £3,142,580 compared with £3,125,870 for the previous year.

Schooled for Use

EXPORTS of aircraft equipment (together with disc brakes and liferafts) by the Dunlop aviation division reached a record figure of £1,900,000 last year. This was 21 per cent up on the figure for 1959, itself a record year.

Announcing the new total, Dunlop say that a factor behind the increase is their aviation servicing school at Fort Dunlop, Birmingham (for tyres), and at Foleshill, Coventry (for wheels, brakes, etc), where for the past fifteen years some 11,642 trainees from different countries have been given free training in the use of Dunlop equipment. The school is open to any member of NATO air forces and to employees of organizations dealing with the construction, maintenance, operation or inspection of aircraft. Students of aviation schools or colleges also attend.

IN BRIEF

Aircraft equipment will be among stainless-steel products on view at an exhibition sponsored by the Stainless Steel Manufacturers' Association of Great Britain at the Mayfairia Rooms, Marble Arch, London W1, from March 8 to May 4.

H. M. Hobson Ltd accounts for the year ended September 30 last show a net profit for the year of £360,116 compared with £364,289 for the previous year.

Mr J. Corbishley, FCA, and Mr S. A. Clodd, MIPRODE, have been appointed to the board of Ekco Electronics Ltd. Mr Corbishley is a director and financial controller of E. K. Cole Ltd; and Mr Clodd, who controls the Ekco factories, was recently made a director of E. K. Cole Ltd.

Mr A. B. Tilleray, formerly with the Sorensen division of J. Langham Thompson Ltd, has been appointed sales manager of the Industrial Control Division of Thorn Electrical Industries Ltd, which is responsible for marketing electronic and electro-mechanical control equipment and systems developed and produced by Nash & Thompson Ltd and the Electronics Division of Ferguson Radio Corporation Ltd.

Hadfields Ltd announce that as from February 1 the marketing in Canada of all products of the Hadfields group of industrial companies is to be controlled and promoted by H. M. K. Sales Ltd (formerly Millspaugh (Canada) Ltd), 3285 Cavendish Boulevard, Montreal. The Hadfields group includes Millspaugh Ltd of Sheffield, Yorks, Wm Kennedy & Sons Ltd of Owen Sound, Ont, and other companies of the Hadfields and Millspaugh groups.

High Duty Alloys Ltd announce that the telephone number of their Extrusion Division, Distington, has been changed to Workington 2581/6.

Ultra Electronics Ltd have received a contract to supply their UA60 intercom equipment for Westland P.531 helicopters being built for the Army Air Corps. Value of the contract, covering 40 sets of equipment, is approximately £21,000. Deliveries are to commence this summer.

Mr C. L. Cowdrey, FRAES, MSAE, formerly manager of the Luton Flight Development Establishment of D. Napier & Son Ltd, has been appointed general manager (Luton). He has headed the Luton establishment since its formation in March 1940, initially as chief installation engineer and since 1951 as manager (Luton).

The Mond Nickel Co Ltd, an affiliate of the International Nickel Co of Canada Ltd, has changed its name to the International Nickel Co (Mond) Ltd. The company are presenting an exhibition of modern industrial metals at the Engineers' Club, Albert Square, Manchester, from March 18 to 22.

Canadian Aviation Electronics Ltd, Montreal, Ferranti-Packard Electric Ltd, Toronto, and DH Aircraft of Canada, Toronto, have announced the formation of a jointly owned subsidiary, DCF Systems Ltd, "to undertake management design, development and manufacture relating to commercial and military equipment programs in those fields where the companies' capabilities and facilities are complementary."

Tiltman Langley Ltd, Redhill Aerodrome, Surrey, have licensed their three-phase rotation and line indicator to the Martindale Electric Co, Westmorland Road, London NW9, who will manufacture and sell the product in the UK and other countries covered by patents. The original instrument has already been supplied to the RAF for use on three-phase 400c/s aircraft supplies.

George Kent Ltd have acquired 51 per cent of the share capital of the Tieghi company of Milan and Lenno and a new concern, Kent-Tieghi-SpA, has been formed. Kent-Tieghi's products at present include recorders and controllers for flow, pressure and temperature of liquids and gases using pneumatic control systems and supported by an extensive series of primary elements, relays and actuators.

Mr Graham Cooke has been appointed group publicity director for the Firth Cleveland Group, heading a new division which will co-ordinate and control advertising and public relations for the Group and its member companies. For the past four years he has been publicity director of the Solartron Electronic Group, now part of the Firth Cleveland Group. He remains a director of Solartron.

Three board appointments have been announced by the Solartron Electronic Group Ltd. Mr L. Malec, MBE, becomes director of systems sales; Mr R. Catherall, BSC, is made director of research and development; and Mr H. D. Binyon becomes director of product sales. Mr Malec joined Solartron in 1959 as managing director of Solartron Radar Simulators Ltd; Mr Catherall joined Solartron Laboratory Instruments Ltd in 1952 as a development engineer; and Mr Binyon joined Solartron Laboratory Instruments in the same year as their first sales representative.

Mr B. W. Townshend, ACGI, FRAES, MIMECHE, has been appointed technical consultant to the R.F.D. Co Ltd on the ditching safety of aircraft and questions relating to search, rescue and survival. He has previously been (since 1938) successively with the Air Ministry, MAP, and Ministries of Supply and Aviation. The company have also announced that 114 lives were saved last year through the use of their equipment.

Elliott-Automation Ltd announce that for certain applications joint marketing arrangements have been agreed between the Rheostatic Co Ltd and Black Automatic Controls Ltd, both member companies of the group. Under these arrangements, Rheostatic will sell the range of Black solenoid-operated valves, pressure and flow switches to the heating, ventilating and air conditioning industries under the name Black-Satchwell, alongside its own range of Satchwell controls. In future the Rheostatic Co will, as appropriate, include Black-Satchwell controls when offering comprehensive control schemes for these industries. Black Automatic Controls Ltd are opening a sales office in London at Steel House, 11 Tothill Street, SW1 (Whitehall 5814-5).

Correspondence

The Editor of "Flight" is not necessarily in agreement with the views expressed by correspondents in these columns. Names and addresses of writers, not for publication in detail, must in all cases accompany letters.

All in the Bag?

THE current controversy over the relative hazards of using JP.4 (aviation turbine gasoline) or JP.1 (kerosine) as fuel for turbine-engined and jet aircraft is as yet unresolved. However, both protagonists are agreed that the over-riding factor from all points of view is maximum passenger safety.

By their very nature all fuels are dangerous when not contained, and in this respect it is interesting to note that the Recommendations Appendix to Chapter D5-2 of British Civil Airworthiness Requirements, Section D, states: "when possible fuel tanks should not be located within the fuselage or the centre section of a wing passing through the fuselage". Also, "where tanks must be installed in locations likely to be distorted inboard of, or adjacent to, the outboard engine, robust bag-type tanks protected against local damage are recommended."

It could well be that the torsion-box integral fuel tank of shear web / integrally machined skin / stringer panel construction is not so "likely to be distorted", but the fact remains that bag-type tanks do have a greater margin of safety at crash case and emergency landing case inertias. This fact is well illustrated by an analysis of results of accidents to aircraft fitted with even light-weight bag tanks.

Turbine aircraft of relatively high wing-loading have large fuel capacity demands, and the fitting of bag-type tanks will reduce the capacity compared to integral tanks. Also, bag tanks incur a weight penalty with a consequent reduction in payload. However, their use considerably simplifies the surrounding structure and in the event of local damage to a bag tank it can be quickly and easily repaired or replaced. The weight penalty incurred would lead to only a marginal increase in cost per passenger-mile—insignificant in comparison with the increase in safety which would be achieved.

The general introduction of bag tanks—particularly in the danger areas inboard of the outboard engines—is long overdue and would allow airline operators to choose either JP.4, kerosine or any other fuel based on their relative technical and economic merits. These facts should be brought to the notice of the public, who rightly expect to travel as airline passengers with maximum possible safety.

Woking, Surrey H. G. MUFF

[That aircraft could accept with greater safety *any* fuel because it is contained within a bag tank is an assumption which, unfortunately, is not warranted. While it may seem that air safety has grown up on a give-with-one-hand, take-with-the-other basis (landing aids have improved, but landing speeds have risen; structural testing is more thorough, but utilization is higher) it is never just a question of restoring the *status quo*. Safety is absolute—however much that standard may afterwards be compromised.—Ed.]

Supersonic Transports

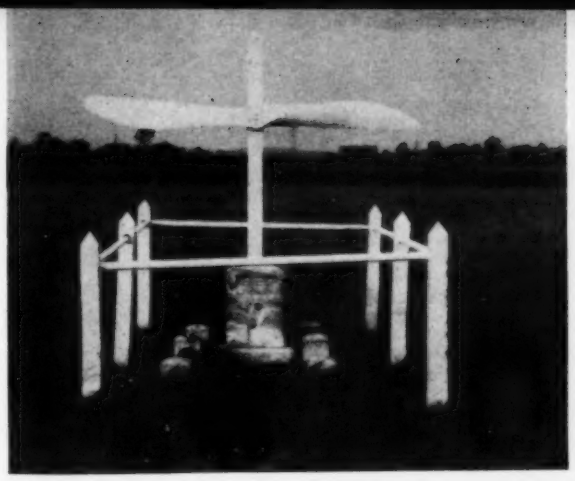
From Sir Roy Fedden, MBE, DSc, FRSA, Hon FRAeS, MIME, MSAE, MIAE, Hon FIAS

BECAUSE of the biggest flood on the Usk for 90 years I was prevented at the last moment from attending the Royal Aeronautical Society's symposium on supersonic transports. I was particularly grateful therefore, for the excellent reports on it in two recent consecutive issues of *Flight* [December 23 and 30, 1960].

From these reports I gather that a number of problems in aeronautics which have been under consideration for a long period, even to before and immediately after the last world war, inevitably came up again in the discussions. The concluding paragraph of your writer struck me as being particularly apt; in it he neatly summed up the symposium by stating that in spite of a first-rate interesting day, the nub of the problem had not yet been faced or realistically tackled.

With this view I wholeheartedly agree. But for a few brilliant exceptions, British aeronautics, in my view, lost its long established initiative, power of concentration and quick action early in the war and has not yet recovered it. Tradition and past mistakes are not worth spending a moment over, except to draw a lesson from.

One speaker remarked that "lots of effort must be placed on the podded engine; it's a runner now, though it did not at one time appear to be." It would seem these comments might have been made more usefully about 15 years ago. Soon after the war Sir Stafford Cripps sent me to Germany in charge of two Dakotas with two jeeps and a group of ten technicians to explore and bring back all possible data on German propulsive techniques, particularly gas turbines and their installation. Amongst the many factories, research laboratories and universities which we visited we spent some days at Volkenröde, near Brunswick, that amazingly advanced research institute. A great deal of it was underground, and the Allies knew practically nothing about it until after the war. We were duly impressed by the comprehensive range of wind tunnels running up to over Mach 3, with instrumentation and equipment the like of which we had never seen before.



Propeller and plaque in the field between Rayleigh and Wickford, Essex, commemorating the spot where an RFC pilot, Capt H. C. Stroud, fell in action in 1918 (see letter, overleaf, from Flt Lt Leslie Hunt)

Some of these were fitted up with an optical interferometer apparatus for studying flow phenomena on models, employing entirely novel methods for detecting changes associated with flow separation round air intakes, and shock waves, under high-speed conditions. We were particularly interested in models of the Messerschmitt P.1101 600 m.p.h.-plus fighter with 40° swept wings and of a four-engine bomber with very neat twin pods enclosing B.M.W. 003 jet engines, which struck some of us as an elegant solution. We were in the course of studying the latter model when suddenly, one night, it disappeared (rumour had it, in a US Air Force jeep driven by a Boeing engineer). This, of course, we never knew for certain, but if it was correct it might well have provided the embryo idea from which the famous bombers and transports sprung.

There appeared to be an unwillingness to study unfamiliar weird ideas and shapes. Had we not won the war? Judging by the demand for copies of our report, the engine people were by far the most interested, whereas several aircraft designers were sceptical about the new configurations which had caused us so much interest.

I feel that the self-righteous way in which the light-alloy M2-cruise supersonic transport has at times been discussed, with warnings and forebodings doled out to those who do not agree with the formula, is rather running to form.

I have not, of course, any means of assessing the value of the hearings on supersonic air transports before the special investigating committee during May 1960 and published by the US Government later that year; but I have read very carefully the evidence given by the North American team with their background on the B-70 bomber, including 14,000 hours of wind tunnel testing and the formidable number of organizations which they have been able to draw upon as regards new materials, etc, culminating in their recommendations to the sub-committee for an M3 supersonic transport within ten years.

This brings me back to the pithy concluding argument of your writer of these reports, which has encouraged me again to press even at this late date for this country to start with an entirely clean sheet and set up an independent commission to work out a ten-year long-term overall plan for what I would call, for want of a better term, the right place of Britain and the Commonwealth in international "Air Power or Aerospace." Both of these terms seem to drive certain people crazy. Perhaps someone can invent a better name for this vital requirement, the most important single factor in our whole material economy.

This whole matter is so vital to our very existence as a power of any importance in the future, and to the continuation of the Commonwealth, that every possible precaution must be taken to avoid compromises in the setting up of the entirely independent commission, which should be given its terms of reference by the Prime Minister, and would have to have its work explored and prepared by an adequate expert briefing staff.

It would have to be free to make its report without any governmental or industrial bias, the influence of the Establishment, or political expediency. It would have to cover recommendations for a complete overhaul of the Treasury and Civil Service systems of control and annual budgeting, for without that it is not rational to expect worthwhile results.

It would have to go to the root of the whole problem on a

CORRESPONDENCE . . .

broad field, including for example, provision to train an adequate force of technologists and engineers over the next 10-15 years on a permanent replacement basis; to review the size and scope of the industry, including all accessory and material sources; to produce sound and adequate research programmes at least on a ten-year basis; and to decide exactly where we stand and what our future interests should be on military, transport, civil and private aircraft, missiles and space activity.

If this were achieved (and it is quite possible to do it, with sufficient priority, enthusiasm and drive in seven to eight months) we should then, for the first time since the war, be on firm ground as to what is within our resources to tackle on a financial, time and scope basis. We should, in fact, be in a position to know if we could give any attention to a supersonic transport at all. If we could, the time factor might be such that we could not permit ourselves to be involved with just any proposal, but, instead, with a conception in which there is most scope for development and possible business return.

In the last decade I have spent a good deal of my time with the up and coming generation of young Britons interested in the air, including a broad cross-section embracing both apprentices and post-graduates. By and large they are good stuff although we are still desperately short of fully qualified men and have not yet received our fair and necessary share of the best available brains in the country. It has fallen to my lot to endeavour to explain our present position in the air and to do my utmost to inspire them with the great opportunities within their grasp and that the position is bound to improve.

If I was one of them today, I should hang on for a bit, because Britain is obviously the best country in the world to work in, and we still possess the basic assets to take our full part in the air; but I must admit I should be extremely disturbed, realizing that up to the present, no realistic effort has been made to go to the root of the trouble and eliminate the canker which is preventing us getting on quickly and thus re-establishing our faith in Britain's air power in the broadest sense.

One hears so often from serious executives both in the aeronautical world as well as in other engineering fields: "These long-term views are all very well, but I have got to keep my shops occupied for the next two or three years and endeavour to make a profit." This short-term outlook of compromise and patching worked all right before the war but today is entirely outmoded. Its failure was first shown up in the aircraft industry because it has the highest and most complex discipline; but eventually, owing to the tremendous step-up in technological tempo, it will apply to all our industrial effort. It has already caught up with us in the shipbuilding, motor and machine-tool industries. The whole country is suffering from lack of long-term planning and research.

Political expediency puts off facing facts and getting down to a genuine start, believing it will cost huge sums of money, whereas in fact it will save money and, what is more, get positive results. The young technologist feels there is too much emphasis put on money, from the board room to the man on the shop floor, and he has something here.

Of course, there must be the profit motif. It is the keystone of the arch, but with a properly planned economy for the air and a dedicated team, profits will look after themselves to a very large extent.

Cape Town — ROY FEDDEN

Lonely Tribute

EVERY day thousands of commuters travel from south-east Essex to London by rail, passing the field between Rayleigh and Wickford on the Southend-Liverpool St line, where a unique link [see photograph, previous page] with World War One is visible on the starboard side when London-bound.

Over the years I have read in local papers and county magazines various reports indicating (a) that a member of the RFC is buried here, where he fell, and (b) that the pilot who fell is buried in Rayleigh churchyard. I thought readers would like to know the truth, which may help to settle arguments in the railway carriages (and I've overheard a few myself).

Tramping across the muddy fields from the road at Shotgate (Rayleigh - Wickford A129) I was able to photograph the alleged "grave" where the well-kept plot and recently painted propeller indicates that *"This spot is sacred to the memory of Capt Henry Clifford Stroud, NRE and RFC. Killed in Action at midnight, March 7th, 1918. Faithful until death.*

None of the locals was able to confirm if, in fact, Stroud was buried there and I was again told that he was lying in Rayleigh churchyard. I checked every grave there without success and then remembered seeing some War Graves Commission headstones in *Rochford* churchyard. Sure enough, there, in the centre of an area in which five RFC/RAF officers are buried, is the family grave of the Strouds, with a stone propeller on the slab and Capt Stroud's details added to the other names of those interred. Inside the parish church, only a few yards from the Southend Municipal Airport boundary, where pilots like "Al" Deere took off in 1940, is yet another link with Capt Stroud, a memorial plaque on the north wall of the old church, placed there by his parents.

Perhaps other readers can add something to this lonely tribute in the Essex fields?

Leigh-on-Sea, Essex — LESLIE HUNT, Flt Lt

Cody and "Colonel"

WHILST acknowledging all the academic arguments about whether Cody was a colonel—or wasn't—wouldn't it be much nicer to leave it that we all knew him as Colonel Cody and the reigning monarch supported the fiction? For heaven's sake let sleeping dogs lie or colonels R.I.P.

Thames Ditton, Surrey — BASIL CLARKE

Hands off Phineas

IN an old copy of *Flight* (July 22, 1960) Roger Bacon has shot down another cherished illusion. A whole generation of boys has grown to manhood convinced that the Spandau guns were as much a part of the First World War as Baron von Richthofen and Billy Bishop.

Who can forget the stirring stories in *Triumph, Wizard, Rover* and *Champion* that included whole paragraphs of rat-tat-tat-tat attributed to these deadly guns?

I must insist, sir, that some things remain inviolate. Next thing, Roger will be telling us Phineas Pinkham never existed.

Quebec, Canada — JACK BAILIE

Don't-mind-noise Dept.

IN my opinion Mr John Connell is way off the mark. He seems to think he has countless secret sympathizers all over the country, ready to leap to the defence of his cause.

When the peace of this district was somewhat upset some while ago (along with many local inhabitants), the newspaper offices were inundated with complaints about the activities of the B-47s. There was even an article on the subject in our school magazine. The newspaper ones were mainly to the effect that "little Johnny was *so* upset. He was off his food for days." Well, it seems that little Johnny and everyone else has now recovered, for on the rare occasions when the subject is mentioned there are few complaints of noise, and no one appears to have suffered any ill-effects.

I am obviously neither responsible for anything that is good in civilization, nor intelligent, nor sensitive, for I think that people living near important jet-used airports will soon adopt the attitude of our local ex-jet-noise-abaters (if they haven't already) so that Mr Connell's noble society will ultimately die through lack of support and interest. Meanwhile perhaps they will amalgamate with the select band of brothers who are convinced that the world is flat. Both causes are equally futile.

PATRICIA HAMMOND (aged 15)

Newbury (nr Greenham Common), Berks

FORTHCOMING EVENTS

Mar	11.	British Gliding Association: Annual General Meeting.
Mar	13.	RAeS Historical Group: "Evolution of Transport Aircraft," by Peter W. Brooks.
Mar	15.	Kronfeld Club: "Collision Experiments with Wire Barrage Weapons," by Gp Capt Kent.
Mar	16.	RAeS Astronautics and Guided Flight Section: Symposium on "Training of Guided-missiles Engineers."
Mar	17.	RAeS Man-powered Aircraft Group: "Power Transmission Systems," by S. S. Wilson.
Mar	17.	Institute of Navigation: "The Long-term Plan for Air Traffic Control," by Capt V. A. M. Hunt.
Mar	18.	London Society of Air-Britain: a.g.m., Annual Recognition Contest and Film Show.
Mar	21.	RAeS: "Some Aspects of Buffeting," by R. Fail.
Mar	22.	Kronfeld Club: Film Show.
Mar	23.	RAeS: Fourteenth Louis Bleriot Memorial Lecture, "Problems of Short Take-off and Landing," by H. Ziegler.
Mar	24.	Society of Environmental Engineers: Annual General Meeting.
Mar	28.	Guild of Air Pilots and Air Navigators: "Supersonic Transport," by Dr A. E. Russell.
Mar	29.	RAeS Agricultural Aviation Group: "Atomization," by R. P. Fraser.
Mar	29.	Kronfeld Club: "An Austin 7 on the Top of the Senate House, Cambridge," by Peter Davy.

RAeS Branch Fixtures (to Mar 17): Mar 13, *Boscombe Down*, "Airships," by the Rt Hon Lord Ventry; *Henlow*, "General Concepts of Space Research and Satellite Launching Vehicles," by D. J. Lyons. Mar 14, *Luton*, "Hovercraft," by staff member from Hovercraft Development Ltd. Mar 15, *Coventry*, "Reliability," by Air Vice Marshal A. F. Hulton; *Hatfield*, "The Strength of England," by Dr Barnes N. Wallis; *Manchester*, Sixth Chadwick Memorial Lecture, "Some Current Problems Facing the Aircraft Designer," by J. C. Floyd; *Reading*, "Development of the Handley Page Herald and H.P.R.8," by J. Allan.

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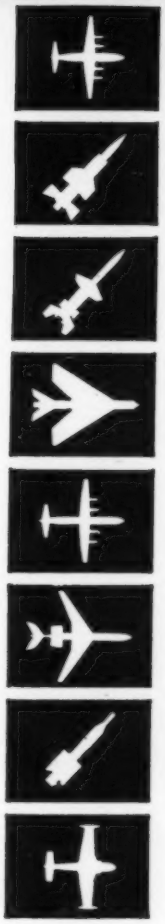

VISCOUNT
VANGUARD
VC 10
BAC 107
SUPERSONIC AIRLINER PROJECT
T-188
CANBERRA
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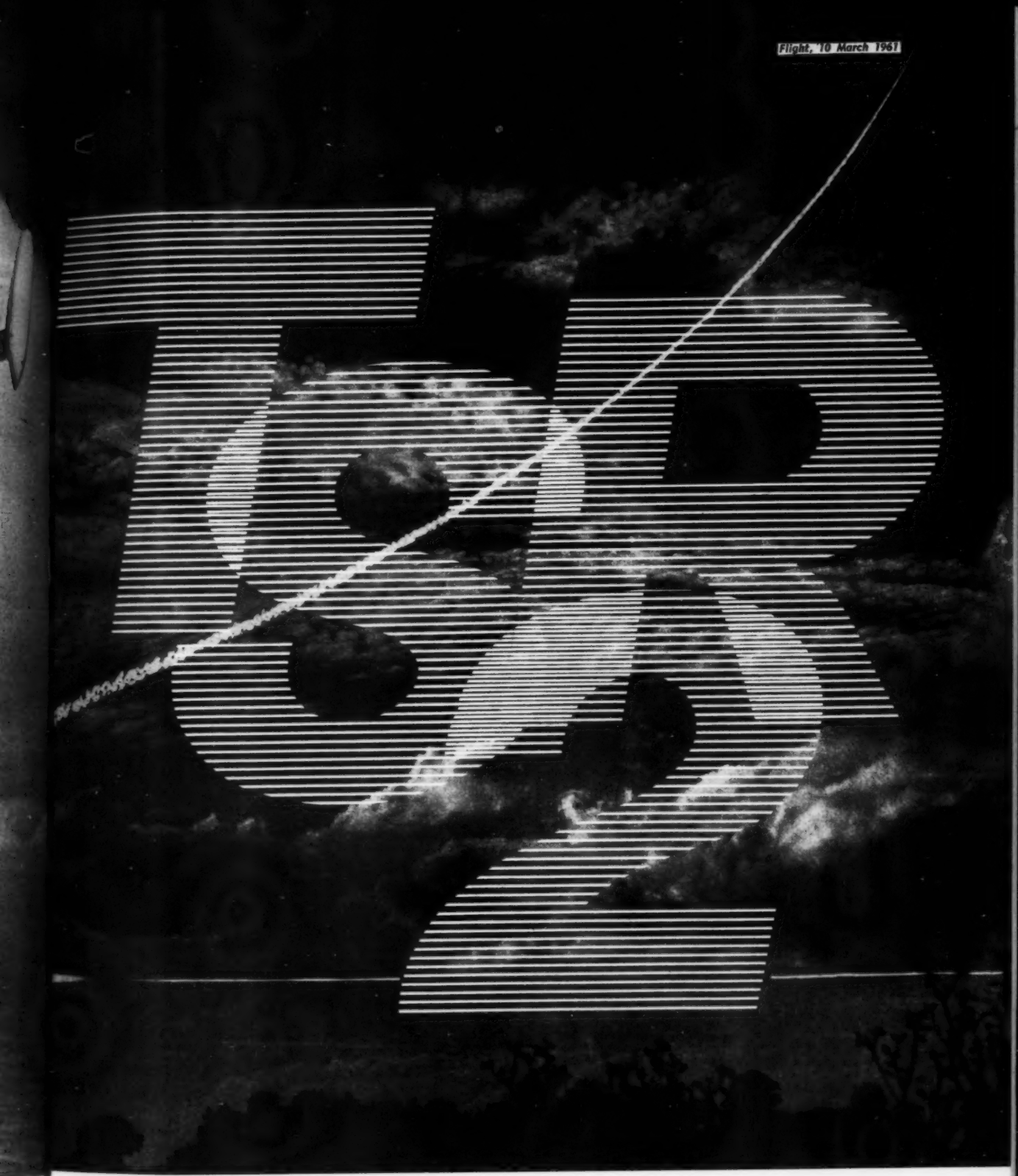

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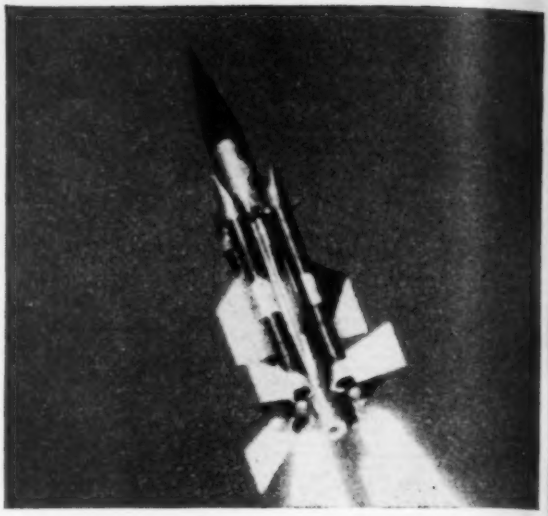
VICKERS **VIGILANT** One-man anti-tank missile easily carried into action by infantryman or paratrooper. The Vigilant's gyro-stabilised velocity guidance system gives greatest accuracy, widest range band, lowest training costs and easiest control.



'ENGLISH ELECTRIC' **THUNDERBIRD** A fully mobile, solid-fuel, air-transportable ground-to-air missile in service with the British Army. A development contract has been placed for Thunderbird Mark II.

4 GUIDED MISSILES FOR WESTERN DEFENCE

BRISTOL/FERRANTI **BLOODHOUND** A long-range, high-altitude, ram-jet powered, ground-to-air missile adopted by the Royal Air Force, Sweden & Australia. Bloodhound Mark II is now under full development.

'ENGLISH ELECTRIC' **BLUE WATER** This tactical surface-to-surface weapon is Britain's second-generation army missile. It has a solid-fuel motor, inertial guidance, high accuracy, rapid fire power and great mobility.

AND BUILT BY

BRITISH AIRCRAFT CORPORATION

ONE HUNDRED PALL MALL LONDON SW1

First direct services to Sicily will be started by BEA Vanguards on June 1. This was the first arrival of a Vanguard in Sicily, which it visited on a route-proving flight to Punta Raisi Airport, Palermo, on February 28

AIR COMMERCE

America's Latest Big Stick

WHEN Thetis held her son Achilles by the heel and dipped him in the Styx, she made his mortal body invulnerable. His adversaries could not dispose of him, and it was Apollo who finally provided the guidance system that directed the fatal arrow at the heel by which his mother had held him. Now the great anti-trust gods in America have found a vulnerable spot in foreign airlines at which to direct their arrows—pool agreements.

Not only has the US Civil Aeronautics Board demanded that foreign airlines operating into the USA should submit full details of their schedules (present and future) and traffic statistics; the latest move is that the CAB examiner, Mr Edward Stodola, has given BOAC, Qantas and Air-India until April 12 to reply to a Pan American submission that these airlines—and others operating in pool into the USA—should give details of their pooling arrangements.

BOAC has already, according to a report from Washington, filed a "counter-motion" asking that the PanAm proposal be rejected. It is now up to the CAB to decide whether the Pan American proposal should be upheld, and that foreign air carrier permits should be amended to give the CAB the right to examine pool agreements.

The United States is the only air transport nation to repudiate pooling, which it regards as a commercial practice in conflict with its anti-trust laws. These laws apply to all holders of US foreign air carrier permits; in other words, foreign airlines do not enjoy immunity from US anti-trust legislation. The recent court case that resulted in gaol sentences for a number of senior executives of America's electrical and electronics industry was an extreme example of the anti-trust lengths to which the Americans will go.

But it has to be *proved* whether pooling of services by foreign airlines is anti-trust. What could happen is that the Senate anti-trust committee will be directed to investigate foreign airline pool agreements, in the same way that this committee conducted its recent great probe into the aviation insurance business (see last week's issue, page 291).

It is clear that the Americans are now going to wield every available big stick in their fight to resist the mounting invasion by foreign airlines of the rich US traffic markets. They are, to sum up, doing two things:—

(1) Demanding that foreign carriers should provide details of their present and future schedules, and also full traffic data—as explained in a previous issue (February 17, page 223-224). This action is presumed to be aimed at providing the CAB with a statistical basis on which to interpret the Bermuda-type agreements that regulate air services between the US and foreign countries. These agreements, it will be remembered, do not prescribe limitations on traffic. They merely agree—rather vaguely—that traffic should be related to supply and demand. The Americans have always deplored attempts by others to control capacity; they are not now doing an "et tu," but they want to be able to interpret the Bermuda principles more scientifically. It is not at BOAC that this particular CAB move is aimed, but rather at the Scandinavians, Dutch and Italians.

(2) As reviewed in this note, the CAB has—so far—upheld a Pan American request that pool agreements be investigated. This move, it appears, is aimed directly at BOAC. J. M. R.

[*Leading article, page 297*]

KILLING THE GOOSE

A DETERMINED attempt to drive away from Heathrow cars that park for more than 48hr is being made by the Ministry of Aviation. New parking charges, amounting to £2 per day for periods of over four days, and £1 per day for periods between two and four days, come into force on March 20 at the Central Area. They will remain effective until October 15.

The Ministry say that tenders will shortly be invited for a multi-storey garage in the Central Area, but until this is built passengers who have to leave their cars for extended periods should apply to the airport management for particulars of local garages which operate a collect-and-deliver storage service. Because the obvious need for parking space was not anticipated, revenue is now being turned away.

BEA AND THE HERALD

IT was in June 1959 that the then Minister of Supply announced that negotiations were in hand with Handley Page for the purchase, at a total cost of about £750,000, of three Heralds for operation by BEA. The object of the order (a similar one, since dropped by Avro, was for the purchase of three 748s) was to improve the export prospects of these aircraft by "an early demonstration of their efficiency in regular operation on normal services in the UK."

Twenty-one months later, in the House of Commons on February 27, the Minister of Aviation announced that "contract negotiations both with the manufacturer and the operator are in the final stages and I hope that agreement will be reached shortly."

The reason for the long delay was discussed in *Flight* for March 6, pages 33-34; the Minister was unwilling to sanction expenditure on an aircraft which, in the event of Handley Page joining Hawker Siddeley, might be bought off in favour of the 748. It appears that the Minister is now reassured on this point.

The Heralds concerned are not likely to be introduced by BEA until early in 1962.

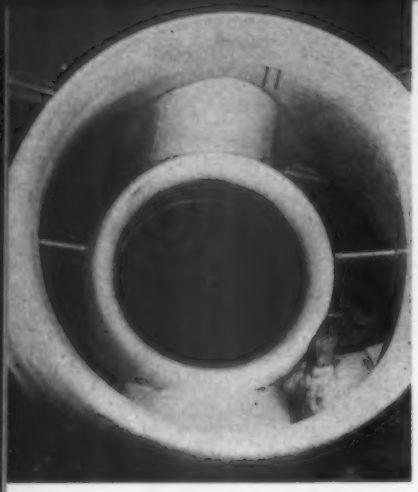
TREKKING FORWARD

DESPITE gloomy prognostications, Trek Airways—South Africa's enterprising long-haul independent—has faced the twin challenge of jet competition and IATA economy fares and can look back on a highly successful 1960.

Last year the number of passengers travelling on Trek's various services to Europe increased by 16 per cent to 6,500, while load factors rose from 84 to 85 per cent. The only discernible effect of other airlines' new economy-class fares turned out to be an increase in the proportion of passengers who booked a single fare instead of the usual return ticket; the reason would appear to be

This South African Airways Constellation 749 is one of those bought by Trek for its services to Europe (see "Trekking Forward," above)

AIR COMMERCE . . .



The 1961 look in air transport propulsion is demonstrated here by a rather pained looking workman on the Convair 990. The engines are General Electric aft-fan CJ-805-23s, of which this is the intake

that a number of travellers were busy sampling the attractions of Trek's leisurely service with overnight stops *en route*, and then comparing it with the direct services offered by IATA carriers. Whatever the conclusions reached by these researchers, Trek Airways are confident that their business has not suffered in the process, for forward bookings continue to pour in; and, as a result, most flights—even at the current lean time of the year—are fully booked some months ahead.

On looking into the future the directors have further cause for satisfaction, for during the next few months Trek will be acquiring pressurized aircraft in the form of two L.749s which were formerly operated by South African Airways. These Constellations will be fitted-out as 70-seaters and will be taking over the night-stopping services. During the first year of operation they are scheduled to fly a total of 52 round flights between Johannesburg and Luxembourg or Dusseldorf. Of this total, 40 will probably be routed across East Africa, with night-stops at Entebbe and Cairo, while the remaining 12 flights are expected to operate via Windhoek, with probable night-stops at Luanda and Kano. In addition to these services, an additional 36 DC-4 flights are likely to be operated each way during the year without night-stops.

Return fares on the stopping services will remain unchanged at Rands 420 and 400 for the peak and off-peak seasons respectively. (In the Union's newly introduced decimal currency, two Rands are equivalent to £1.) On the new direct service, however, an even lower tariff is proposed; provisional return fares are likely to be set at about Rands 360 (£180) in the season and Rands 300 (£150) in the off-season. These new fares will bring the cost of air travel on this traditionally expensive route down to less than the cost of sea travel. In the circumstances, Trek expects to see a 50 per cent expansion in its business once the Constellations are in full operation.

The cordial relationship between South African Airways and Trek is evident from the fact that SAA will in future be responsible for all Trek's major engineering. A factor that has undoubtedly brought these two airlines together has been the growth of dubious closed-group charters and of other evasive activities on the part of various European non-scheduled carriers. By enlisting the support of a company which has established a sound reputation, based upon seven years' reliable and successful low-fare operation, the South African authorities seem to have found a particularly happy formula for allowing the public the benefits of low-cost air travel without prejudicing the interests of the State airline.

This photograph from Aircraft Furnishing bravely invites judgment of Lonsdale Flyweight seats—and the 30in pitch at which they are installed in BOAC's Skycoach Britannias. Special features are tip-up intermediate arms and seats, and struts that are kept clear of shins. The seat is shown fully reclined, and the girl is 5ft 7in tall

WORLD'S BUSIEST AIRPORTS

BUSIEST airport in the world, by almost any method of reckoning, is Chicago Midway. In 1960 it handled 376,030 aircraft movements, over 50,000 more than any other airport in the United States, but nevertheless 55,000 movements fewer than in 1959. Even so, the 1960 total is more than the sum of air transport movements at *all* United Kingdom airports in 1959, and is equivalent to one take-off or landing every 1.4 minutes, night and day. Idlewild, by contrast, handled 274,634 aircraft in 1960 and London (Heathrow) 146,500.

Of Midway's total movements 298,582 (79 per cent) were air transport operations and 347,474 were departures or arrivals on what the Federal Aviation Agency describes as itinerant flights—that is to say operations to and from any other point. The remainder (7.6 per cent of all movements) were local operations. Only on the score of departures and arrivals by general aviation aircraft was Midway last year eclipsed by other US airports. Busiest general aviation airport in 1960 was Phoenix, Arizona.

Statistics on US airports in 1960 are published in a booklet* recently made available by the FAA. In view of current interest in increasing the utilization of Britain's airports as an aid to profitable operation, movements in each category at the top ten US airports, and the relative position of London (Heathrow) are summarized in the table below. Note that the figures for London are provisional, no firm figure yet being available for the year 1960, nor is any breakdown of air-transport movements available for December. This is in unhappy contrast to the airfield statistics prepared by the FAA, whose breakdown of movements at 229 major US airports was issued on March 1 and was in *Flight's* office by March 3.

LONDON AND THE BUSIEST US AIRPORTS, 1960

Total Movements			Air Transport Movements		
(1)	Chicago, Midway ...	376,030	(1)	Chicago, Midway ...	298,582
(2)	Tamiami, Florida ...	321,605	(2)	New York, Idlewild ...	239,617
(3)	Miami	321,017	(3)	Washington, DC ...	226,512
(4)	Washington, DC ...	316,597	(4)	Los Angeles	216,086
(5)	Denver	308,194	(5)	La Guardia	173,611
(6)	Phoenix	294,044	(6)	Miami	167,176
(7)	Los Angeles	289,026	(7)	Chicago, O'Hare ...	163,351
(8)	New York, Idlewild ...	274,634	(8)	Atlanta	163,243
(9)	Long Beach	271,818	(9)	San Francisco... ...	146,022
(10)	Dallas	256,816	(10)	Dallas	146,009
			(11)	Newark	140,760
(55)	Sacramento, Calif. ...	147,309	●	†London (Heathrow)	134,626
●	*London (Heathrow)	146,500	(12)	Boston	119,593
(56)	Birmingham, Ala. ...	144,086			

*Provisional. †Twelve months ended November 1960. **No local movements.

Perhaps the most remarkable feature of this survey is the increasing relative importance, in terms of aircraft movements, of London Airport. When we last examined the position of London in relation to US airports in May last year, total movements at London were about the same in number as those at Winston-Salem, NC, which was placed 82nd on the US list. This year, London has moved up to the equivalent of 56th place on total movements and a surprising 12th place in terms of air transport arrivals and departures.

The reason is that, while movements at London have increased quite rapidly in the past year (air transport movements are up from 118,000 to 134,000, total movements from 130,000 to 146,500) movements at US airports have declined. Every previous year since 1952 has been a record year for US airports, but between 1959 and 1960 movements were down by four per cent. The total was still well over 25m.

THREE PILOTS, FOUR SECTORS

CREWING of the Comet 4B was never a real issue between BALPA, the pilots' association, and BEA's management, and Comets were introduced in April 1960 with three pilots. But as a note in our February 24 issue ("No Fourth Sector") indicated, BEA's pilots feel that they are being asked too much of schedules that call for four-sector flights.

Always in BEA's mind, it seems, is the feeling that their pilots are not being utilized at a rate commensurate with their salaries. Typical salary of a BEA Viscount skipper before the wage increase in 1960 was £2,225 to £2,900 depending on seniority. The salary increase (which was back-dated nine months) raised these salaries to £3,150-£3,800 or to £3,750-£4,400 for Viscount pilots who transferred to Comets. In addition to their salaries, pilots have

* *FAA Air Traffic Activity, Superintendent of Documents, Government Printing Office Washington 25, DC.*

Pilots of the BOAC Boeing 707 which on March 2 inaugurated the Montreal - Los Angeles leg of the corporation's new route from London to California were the father-and-son team of Capt Gordon R. Buxton (left) and 1st Offr Gordon James Buxton. The service will operate twice-weekly, and thrice-weekly from May 1; the 10hr 50min eastbound crossing will be non-stop

good pensions and life insurance, they receive generous allowances for meals and accommodation, and they have a minimum number of days off during the year amounting to 110.

The Parliamentary Select Committee which took evidence on the affairs of BOAC and BEA two years ago reported (before the BEA pilots' wage increase): "If BEA are to improve their cost/c.t.m. ratio, it must be by improving either aircrew utilization or aircraft utilization or both." As a note on page 224 of *Flight* for February 17 showed, BEA's cost level has been going up at a disquieting rate. Last year it was the highest it has been for six years. It must also be recorded that despite favourable circumstances in the year 1959-60 (such as exceptionally good flying weather) BEA's pilots flew fewer hours in that year than they flew on average during each of the previous five years. The actual figures are: captains, 575hr compared with 587hr; first and second officers, 553hr compared with 564hr.

Future trends in the utilization of BEA's aircrews—which Mr Anthony Milward, chief executive of BEA is on record as describing as "vital to our economy," will be watched attentively. The upward trend in BEA's cost level is of course not wholly attributable to increases in the pay of their pilots, or decreases in the hours they fly. But the "fourth sector" issue threatens to put further pressures on BEA's cost level.

TCA PILOTS FOR BEA

DIFFERENCES of opinion between TCA and the Canadian pilots' union, CALPA, about crewing the Vanguard are, so far as the pilots are concerned, "based on technical and operational considerations." TCA maintain that a two-pilot crew is sufficient for the safe operation of their Vanguards, and one of the results of this policy is that the airline intends to "furlough" 103 pilots this year.

According to CALPA, "certain industrial considerations" cannot be ignored, and the union says that many of the furloughed pilots "will be absorbed by BEA, who require additional pilots because the corporation plans to operate its Vanguards with three pilots." To the Canadian pilots "who must leave their country in order to continue their professional careers" the irony of the situation, says CALPA, is particularly apparent. BEA have, in fact, now signed on 37 TCA pilots; the first will start work next month. BEA are also to recruit ex-RCAF pilots.

SUPPORT FOR RIDDLE

SUBSIDY to be paid to Riddle Airlines over a five-year period is likely to be about two million dollars a year. This is the estimate put forward by a CAB examiner in announcing an initial decision in the US domestic cargo-mail service case. Other recommendations in favour of this Argosy operator were for long-term certification and the authorization of new routes.

The subsidy recommended by the examiner, Merrit Ruhlen, was made in view of "the enormous potential awaiting a small drop in rates, the development of which has already occurred, and the need of the country for fast freight service." Air cargo, he said, should not be entrusted solely to carriers providing passenger services; greater ingenuity and effort may be expected from an independent operator." Riddle's position as a going concern which has detailed plans for providing north-south all-cargo schedules, he said, "compels its selection." Subsidy payments to Riddle on a ton-mile basis will be only about 20 per cent of those granted to local-service passenger airlines.

The new routes which Riddle may get—and which could mean the first real commercial "break" for their Argosies—are between Boston, New York, Philadelphia, Atlanta, Birmingham, and New Orleans. Another all-cargo service will connect the major cities of the mid-west. Riddle estimates that these new routes should result in their revenues rising by a quarter.

"THE MODERN AIRLINER"

PETER BROOKS has done what many people hoped he would do. He has brought together between two covers the essence of his writings about the evolution of the commercial transport aeroplane. Readers of this journal will recall his series of articles in 1958, "The Origins of the Modern Airliner," and the book that has just been published* offers more besides.

The author is something more than an aeronautical historian; he also, as Sir George Edwards points out in his foreword to this new book, "brings to the subject a personal and professional knowledge of [the modern airliner's] background." For the past ten years Mr Brooks has been with BEA as assistant to the chief executive, and, until his recent appointment as fleet planning manager, as assistant to the chairman. So he has been in close touch with transport aircraft developments during the past fifteen years; he is a player as well as a spectator.

Mr Brooks suggests that the development of the transport aeroplane tends to go in twenty-year cycles, of which there have been three so far:—

(1) 1900-20: the evolution of the practical aeroplane;

(2) 1920-40: the era of the piston engine transport aeroplane, and the pioneering era of airline services. Speeds from 80 to 200 m.p.h.

(3) 1940-60: the era of the development of subsonic jets and helicopters, and of the consolidation in airline service of "the DC-4 generation." Speeds ranged from 200 to 400 m.p.h.

The next cycle, 1960-80, will (the author goes on) witness the consolidation in airline service of subsonic jets and helicopters, and the development of supersonic airliners and VTOL. Hoping that his twenty-year cycle will apply also to technology in the latter part of this century, Mr Brooks suggests that the 1980-2000 period will see the establishment of supersonics and VTOL, and the development of boost-glide rockets and the further development of VTOL. So much, it seems, for the generally accepted assumption that 1970 will see the introduction of supersonics—if Mr Brooks' twenty-year cycle thesis is accepted (and if the wishes of most airlines are respected) people will not be flying in supersonic airliners until 1980.

However, he allows himself to pose the possibility that "perhaps the supersonic transport era will follow [as civil developments have followed military developments in the past] ten years after the first flight of the first long-range supersonic cruise military aeroplane—which at the moment looks as if it will be the North American B-70 due to fly in 1963."

On the subject of VTOL, the big issue according to this book

**"The Modern Airliner" by Peter W. Brooks. Putnam & Company Limited, 42 Great Russell Street, London, WC1, price 30s.*

Last month a newly overhauled and repainted DC-3 was sold to Royal Nepal Airlines by PIA. The price was £17,000. At the handing-over ceremony were (left to right) M. M. Salim, planning manager, PIA; Aijaz Ali, engineering manager, PIA; M. I. Akhter, chief engineer, PIA; Brig-Gen Hem Bahadur, general manager Royal Nepal Airlines; and Mr Green, works manager, RNA

Delivery to United of the Caravelle 6R—of which this is a new air-to-air impression—will probably begin in April or May and be completed by January

AIR COMMERCE . . .

is "whether the airlines should go for a lower-cost short-haul vehicle than is possible with VTOL, but which will have take-off and landing characteristics which normally preclude operations right into the centres of cities . . . The majority view in the airline industry, at the moment, seems to be against the STOL solution and in favour of VTOL." A final assessment must, says Mr Brooks, depend on the comparative economics and operating problems of VTOL and STOL vehicles.

Perhaps the most significant passage in this book is as follows:—

"Formula specific costs have been reduced by nearly two-thirds during the past three decades. On the evidence of the formula used the jets will continue this trend in the 1960s."

Coming from someone who has been very close to the subject of jet operating costs, and who—like many others—has probably had his doubts about them, this is a highly significant statement.

TOO NOISY OR NOT?

ON March 3 the Westland Rotodyne, Ron Gellatly piloting, carried out a series of noise tests over London, flying up and down the river and alighting at the Battersea heliport. The tests were ordered by Mr Peter Thorneycroft, Minister of Aviation, who observed and listened in company with Mr Julian Amery, the Air Minister. Noise measurements were made at a number of points, in particular in the location of the heliport during hovering, alighting and take-off.

Last August Lord Douglas, chairman of BEA, said of the corporation's tentative order for 14 Rotodynes: "We don't want to spend £5 million on an aircraft if the Minister says it is too noisy and we can't operate it from city centres." Since that date BEA's interest has been focussed as an insurance on the Westland (Bristol) 194 project, and a decision has to be made soon about the case for continued Government support of the Rotodyne.

ROTTERDAM AND ITS OPERATORS

FORMED recently to take advantage of rapidly expanding traffic through Rotterdam Airport—now in its fifth year of operation—is the new Dutch airline Rotterdamse Luchtvaart-expeditie Maatschappij. The founder, J. van der Toorren, has bought from BEA a DC-3 for non-scheduled passenger and freight charters which he will fly himself until other crews are trained. Another operator is Aero-Taxi, who are also considering the purchase of a DC-3 for charter work; at present they operate a Do 28 and Safirs but may buy Apaches or Aztecs.

Passengers through Rotterdam last year were more than double the total handled in 1959; freight was up by 82 per cent. As a result, larger aircraft should soon be using the airport and the main runway will next year be extended from 4,300ft to 6,000ft. Shoulders will be constructed on both sides, and bearing strength will be adequate for aircraft of up to 100,000lb gross weight in dual-wheel configuration. ILS was installed last December.

BOAC TO WASHINGTON

NOT until now has BOAC decided that the time is opportune to exercise the right which it has always had to operate a service to the US capital. Amendment of the corporation's US foreign air carrier permit was sought a few months ago; approval was in due course given by the CAB, and the necessary piece of paper is now in the White House awaiting the signature of President Kennedy.

Subject to completion of this formality, BOAC intend to operate a 707 service from London to Washington on June 2 at a frequency which, after the first week, will become daily. Routing will be via New York or Boston.

HAWAIIAN AIR FERRY?

FURTHER to a previous note that Aloha Airlines of Hawaii are considering the purchase of Argosies, it is now understood that the proposal being considered calls for two AW.650s and one AW.670 to establish, in about two years' time, an air ferry service linking the six main Hawaiian islands. The aircraft, under one proposal, would be purchased by the State, and operated by either Aloha or Hawaiian Air Lines on a subsidy. The plan is supported by Aloha but opposed by Hawaiian.

Purchase price of the three aircraft would be $6.5 million, and the subsidy might amount to $2.8 million during the first six years, after which the service would be self-supporting. The first Argosy would be delivered on July 1, 1963, a second on October 1, 1963, and the third—which would be an AW.670 (the specialized car ferry)—on July 1, 1964.

AUTOMATIC ATC IN BRITAIN

THE Ministry of Aviation has placed a contract with Elliott Brothers (London) Ltd for an experimental system, based on an Elliott 502 computer and special display equipment, intended for research by the MoA's ATC Experimental Unit into the design of future ATC centres.

The system, which will accept both simulated and live inputs, will be used to test new procedures and use of airspace for the improvement of traffic flow; improvements in data handling, display and transfer; use of computers with inputs from primary and secondary radar, navaids and flight plans; and procedures to deal with new aircraft and greater traffic volumes. Initially, the system will simulate control in the London FIR, using flight plans, radar and position reports, and will have radar, television, electro-mechanical and c.r.t. displays. Other equipment will be evaluated as it becomes available. The studies will concern airways traffic and aircraft joining, leaving and crossing airways.

This represents a first step towards extensive automation in regional air traffic control in Britain. A year has already passed since the initial order was put out to tender and several more must elapse before an operational system is finalized and installed. Slow, steady progress is a reflection of the apparent determination of controllers not to accept new equipment or methods until they are thoroughly proved—a sharp contrast to the American approach of a complete system-study and immediate order for a nation-wide semi-automatic system.

Already nearing completion for a rather different application is the Ferranti Apollo computer to be installed this summer in the Oceanic Area Control at Prestwick. Experiments here will be directed towards investigating the use of automatic equipment, standardizing the flow of information into the Oceanic ATCC, acquiring statistical information for airspace utilization, deciding the apportionment of work between controllers and computers, assessing and testing display equipment, and developing new procedures for the North Atlantic. The experimental programme at Prestwick will last at least three years and may also provide information of value to ATC in general.

Channel Air Bridge have been running special five-day army transport courses to demonstrate to army transport officers routine freight handling and the employment of special aircraft. In the back row, left, is Mr D. A. Whybrow, director of Channel Air Bridge and an old Army transport man himself

MR JUSTICE CAIRNS REPORTS

FOR many years there has been criticism of the manner in which accidents and incidents to civil aircraft were being investigated. Anomalies and apparent injustices also existed in the legislation concerning personnel licensing. Publication last week of the report* of the committee appointed in 1959 under the chairmanship of the Hon Mr Justice Cairns to enquire into the law and practice covering the investigation of accidents, and the cancellation, suspension or variation of flight and maintenance licences, shows it to be a new and, it is to be hoped, influential look at accident investigation.

Since the primary object of any investigation should be the prevention of similar accidents in the future, and because the present regulations do not emphasize this object sufficiently, the Committee recommends that this main purpose be stated more clearly. Wherever appropriate, accident reports should refer to previous accidents of a similar nature. This will enable trends or patterns in causes to be established more easily and might, for example, have prevented some of the mis-read altimeter incidents. It is also recommended that a greater proportion of accidents and incidents should be investigated. There should be more public accountability; with certain reservations, unpublished inspectors' investigation reports, notes the Committee, should be made available on demand to the public.

Despite the great skill and experience of investigators, BALPA and others have always thought that if anything the pilot did or did not do called for investigation, then the investigating team should include a pilot who is familiar with the aircraft type and with the route. A recommendation to that effect has now been made.

A clear recommendation is made that an independent review tribunal should be set up to which appeal could be made against the findings of an inspector's investigation; this does not include public enquiries or foreign investigations. This is something which will be welcomed, as criticism has often been levelled at the finality of an inspector's report. The Committee also recommends that appeals on points of law could go to the High Court.

The recommendation that an investigation should be reopened if new evidence becomes available is another step towards avoiding findings which might be compromised by insufficient evidence.

Under the present regulations a court of inquiry can recommend cancellation or variation of a licence. Although this power has not been much exercised, emphasis on the licensing situation of individuals involved in accidents has sometimes tended to detract from a court's primary function of determining the causes of an accident. The Committee recommends that these recommendations be removed from the legislation.

It was suggested to the Committee that the accredited UK representative to a foreign investigation should prepare an independent report which would then be published. The Committee did not accept this completely, recommending that such a report be published only at the Minister's discretion, and only then if it showed that foreign findings of the investigation were seriously unsatisfactory. But the report makes the fundamental point that it should be made clear that when the report of a foreign investigation is published in the UK it does not necessarily represent the conclusions of a UK authority.

At the time of the coroner's inquest on those killed in the Viking accident at Southall, criticism was made of the lengthy and detailed investigation of witnesses and evidence, and the conflict this caused with the accident investigation branch of the Ministry of Aviation. To avoid such conflict the Committee recommends that when no conclusion can be reached the inquest be adjourned until after the inspector's investigation or public inquiry.

The BEA Elizabethan accident at Munich highlighted a case for postponement of licence action against a pilot involved in a foreign investigation until he had been given the opportunity to state his case. With Captain Thain a proper inquiry was not set up until after questions had been asked in the House. The Committee recommends that licence action be postponed until the holder has been given the opportunity to state his case and an inquiry into the circumstances has been conducted on behalf of the Minister. There should also be an independent Appeals Board.

The Minister of Aviation has said that the proposals are "broadly acceptable."

**Report of the Committee on Civil Aircraft Accidents: CAP 169, HMSO, 4s 6d.*

BREVITIES

Central African Airways have purchased a Viscount from MEA, bringing their fleet to five. CAA said that they "encountered considerable difficulty in locating an operator who was prepared to sell a Viscount."

First hearing of the Air Transport Licensing Board is set for next Tuesday, March 14, at 3 Dean's Yard, Westminster. Two applications, both inclusive tours from Glasgow, are to be heard: Channel Airways to Ostend (objected to by Pegasus Airways), and Air Safaris to Palma (objected to by Starways, Overseas and Pegasus). The hearing, in public, begins at 2.30 p.m. It is hoped that Cunard Eagle's North Atlantic case will start on April 18, and that the British United and Cunard Eagle European cases will start on May 16.

Passengers carried by British airlines in 1960 rose by a quarter and total traffic increased by more than a fifth. Both BOAC and the independent airlines last year increased their available seat-miles by about 31 per cent, and were rewarded with passenger-mile increases of 29 and 27 per cent. BEA offered over 21 per cent more passenger capacity and increased passenger miles flown by 20 per cent. These figures appear in the Ministry of Aviation operating and traffic statistics for 1960, just received, which we hope to review shortly.

The FAA's five Convair 440s, which are used for navaid calibration, are to be converted to Allison 501-D13 turboprops by Pacific Airmotive by October 1961 at a cost of about $3m.

Air-India has obtained the right to extend their Delhi - Moscow service beyond Moscow. At the same time Aeroflot have been given "beyond" rights from Delhi to Rangoon and Djakarta.

United Air Lines personnel are undergoing a course at Crawley, Sussex, on a Redifon Caravelle flight simulator, of the type to be installed at United's training centre in Denver.

According to the Minister of Labour *Gazette*, average earnings by workers in the UK air transport industry is £17 19s 7d per week, compared with a national average of £14 10s 8d.

Cost to the taxpayer of the Princess flying-boats to date has been about £9,127,000, including storage costs of about £5,000 a year. The Ministry of Aviation has so far received "some inquiries" in response to advertisements inviting offers.

New orders for Fokker Friendships are announced: Braathens have ordered a fourth and taken an option on a fifth; All Nippon Airways has increased its order from three to six, and given a letter of intent for up to five more; and Philips Gloeilampenfabrieken of Eindhoven have ordered an executive version. Total number of Fokker Friendships sold is 91, 82 having been sold also by Fairchild.

The Minister of Aviation, Mr Peter Thorneycroft, told the House of Commons on February 27 that though British thinking on the supersonic airliner was on the basis of Mach 2, "there is some reason to believe that American preference would be for the Mach 3. Whatever is decided upon, we should, I think, attempt to do it as an international co-operative effort."

Last Wednesday, March 8, Cunard Eagle was to take delivery of a second Britannia, and a third is due to be delivered on May 1. Both aircraft have been bought from Canadian Pacific, who have operated a fleet of six Britannias since May 1958. The aircraft will be used on Cunard Eagle's routes to Bermuda, Nassau, and Miami, and also between New York and Bermuda. Eagle is also evaluating the CL-44, Boeing 707-420, Vickers VC10 and VC11, DH Trident, Vickers Vanguard and the Douglas DC-8.

Recently Aer Lingus flew to Dusseldorf seventeen local managers of airlines represented in Manchester. From left to right they are:—

Front row: Eric Allamand (Aer Lingus), Tom Seale (Air India), Don Kirkman (UAT), Gordon Erridge (BEA), Dean Hewitt-Dean (Air France), K. Leahy (PanAm), and Harry Edge (BUA). On steps: Ron Beavis (Iberia), R. Nathan (El Al), Charles Mansbridge (CPAL), Ray Marsden-Smith (TWA), Eric Humphries (KLM), Jim Hawkins (MEA), Geoff Bingham (Alitalia), John Flannery (SAS), J. Koski (TCA), and John Wardropper (BOAC)

First air-to-air photograph of a CF-104 Super Starfighter in RCAF markings. There are to be eight squadrons of these aircraft (built by Canadair, Montreal) in the European Air Division of the RCAF

SERVICE AVIATION

Air Force, Naval and Army Flying News

CSE Commandant

AWARDED the DSO in 1945 for operations while commanding No 178 Sqn with the Mediterranean Allied Air Force, and until recently Director of Flight Safety at Air Ministry, Air Cdre J. C. Millar has become Commandant of the Central Signals Establishment. The operations, carried out in Liberators against heavy opposition, were low-level mine-laying in Venice harbour and an attack on railway sidings at Graz. Aged 47, he was Chief Signals Officer at Bomber Command in 1954.

Ark's Busy Commission

AFTER a very busy 15 months (her third general service commission) HMS *Ark Royal* returned to her home port, Devonport, last week. Much of the commission was spent in the Mediterranean, but the carrier also went up to the Norwegian Sea area for the NATO exercise Swordthrust and recently spent ten days in the Davis Strait (west of Greenland) for cold weather flying trials. Her squadrons (Scimitar, Sea Vixen, Gannet and Whirlwind) have flown 8,500 sorties, 450 of them at night; her catapults have launched 2,400 Scimitars, 1,100 Sea Vixens and 400 Gannets, in addition to visiting aircraft; and over 3,000 helicopter flights have been made. *Ark Royal* has steamed 80,000 miles during her latest commission and been at sea for 56 per cent of her time away from the United Kingdom.

Maldive Anniversary

GAN, the 1½ mile by three-quarters of a mile coral island in the Indian Ocean midway between Aden and Singapore, has just ended its first year of full operation as an RAF staging post. During that time, 630 aircraft have been turned round, 12,500 passengers and 1¼mlb of freight handled.

The airfield and its facilities were developed as a replacement for Katanayake in Ceylon, and form part of the Far East Air Force, whose aircraft transported half-a-million lb of stores and equipment a month between the bases from June 1959 until the transfer was completed in February last year.

Gan now has an 8,700ft concrete runway; its navigation and instrument landing aids facilitate the handling of all types of Service transport aircraft by day and night. Its rescue co-ordination centre covers one of the biggest search areas in the world, six or seven times the size of India. Two Shackletons of No 205 Sqn from RAF Changi, Singapore, are permanently stationed on the island for ASR duties.

The Queen with a replica of the Pakistan Air Force badge presented to her by the C-in-C, Air Marshal M. Asghar Khan, at a dinner at PAF Peshawar during her visit to Pakistan. On the right is Begum Asghar Khan. The replica is in gold, silver and diamonds

IN BRIEF

The VCAS is now Air Chief Marshal Sir Edmund Hudleston. His promotion from the rank of air marshal, from March 1, was announced in the *London Gazette* for February 28.

The aircraft carrier *Victorious* had 20,000 visitors during her recent stay in Cape Town.

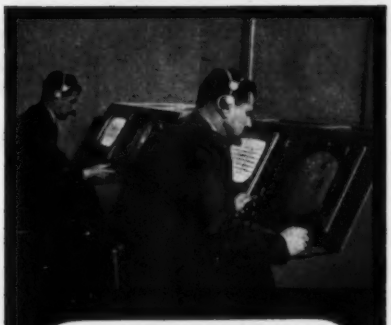
A new headquarters for No 4 Group, Royal Observer Corps, was opened at Colchester last Saturday by Col Sir John Ruggles-Brise, Lord Lieutenant of Essex.

Gp Capt R. F. L. Hart, FCA, has been appointed an ADC to the Queen in succession to Gp Capt (Acting Air Cdre) C. V. Mears, CBE, FCA, on the latter's retirement from the RAF.

The forty-fourth officers' reunion dinner of No 46 Sqn is being held on April 22, with the traditional ladies' luncheon on the following day. Details may be obtained from Sqn Ldr Peter Gifkins, RAF Linton-on-Ouse, York.

Air Cdre A. W. Bigsworth, CMG, DSO, AFC, first officer to drop a bomb on to a Zeppelin in flight and to destroy a submarine by bombing, died recently at the age of 75. He won a Bar to his DSO in 1917. From 1931 until his retirement in 1935 he was Director of Equipment at Air Ministry.

Scimitars on the flight deck of HMS "Ark Royal" during cold-weather flying trials in the Davis Strait, west of Greenland *(see Col 1)*



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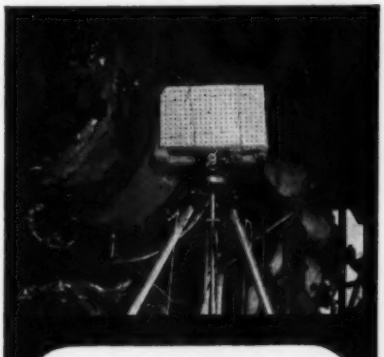

RESEARCH

Observation of after burning in a gas turbine engine at a government research station. This is typical of the many research applications for which television is being used to-day.

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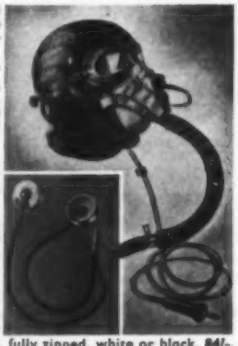

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Printed in Great Britain for the Publishers, ILIFFE TRANSPORT PUBLICATIONS LTD., Dorset House, Stamford Street, London, S.E.1, by SUN PRINTERS LTD., Watford and London. Flight can be obtained abroad from the following: AUSTRALIA AND NEW ZEALAND: Gordon & Gotch Ltd. INDIA: A. H. Wheeler & Co. CANADA: The Wm. Dawson Subscription Service Ltd., Gordon & Gotch Ltd. SOUTH AFRICA: Central News Agency Ltd.; Wm. Dawson & Sons (S.A.) Ltd. UNITED STATES: Eastern News Co., 306 West 11th Street, New York 14.

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